ALTERNATIVES IN DEBT MANAGEMENT: INVESTIGATION OF TURKISH DEBT IN AN OVERLAPPING GENERATIONS GENERAL EQUILIBRIUM FRAMEWORK

The Institute of Economics and Social Sciences of
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by

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ABSTRACT

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Ebru Voyvoda
PhD in Economics
Supervisor: Prof. Dr. Erinç Yeldan
July 2003

The purpose of this dissertation is to investigate the fiscal policy alternatives on debt management, cohort welfare and growth for the Turkish economy. The dissertation is decomposed into two major parts. The first part outlays the issue of debt management and examines the macroeconomic effects of the current austerity program in Turkey, and illustrates the sensitivity of the program targets to growth shocks. The second part takes one step further to develop fiscal policy alternatives on debt management with emphasis on "productive expenditures" of the public sector and endogenous sources of growth. To this end, a large-scale, overlapping generations general equilibrium model with intertemporally optimizing agents and open capital markets, calibrated to the Turkish economy in 1990s, is developed. The results indicate that the current fiscal program based on the primary surplus objective succeeds in constraining the explosive dynamics of debt accumulation, yet suffers from serious trade-offs on growth and fiscal targets. The main suggestion of this study is that alternatives of fiscal programming do exist and it is important to carefully weigh the dilemmas and merits of each of these alternatives.

Keywords: Turkey, Debt Management, Fiscal Policy, Overlapping Generations Models, Endogenous Growth

ÖZET

BORÇ İDARESİ ALTERNATİFLERİ:
ARDIŞIK NESİLLER GENEL DENGE MODELİ ÇERÇEVESİNDE
TÜRKİYE EKONOMİSİ İÇİN BORÇ ANALİZİ

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Bu tezin amacı Türkiye ekonomisi için uygulanabilecek alternatif kamu maliyeti ve kamu yatırım stratejilerini, borçluluk kısıtı, nesiller arası refah ve büyüme çerçevesi içerisinde analiz etmektir. Tez iki ana bölümden oluşmaktadır. İlk bölümde "borçluluk" ve "borç idaresi" konuları ele alınmakta ve bu çerçevede faiz dışı birincil bütçe fazlası hedefine dayanan mevcut programın makroekonomik etkileri ve bu hedeflerin dışsal büyüme şokları karşısındaki kırılganlıkları incelenmektedir. İkinci bölümde ortaya konmuş olan problemin çözümleri aranmakta ve "kamu üretken harcamaları" ve "büyüme kaynakları" göz önünde bulundurularak alternatif kamu maliyesi ve borç idaresi politikalari üretilmektedir. Bu çalışmada geliştirilen model geniş ölçekli, ardışık-nesiller genel denge modelidir. Model, 1990'lar Türkiye ekonomisine kalibre edilmiştir. Çalışmanın sonuçları, mevcut programın kamu borç yükünü hafifletmekle birlikte kamu faiz dışı harcamalarını ve sosyal altyapı yatırımlarını kısıtlamakta olduğunu göstermektedir. Bu çalışma çerçevesinde uygulanan analitik yöntem gereği soyut düzeyde tutulan sonuçların en önemli vurgusu iktisat politikası alternatiflerinin var olduğudur.

Anahtar Sözcükler: Türkiye, Borç İdaresi, Maliye Politikası, Ardışık Nesiller Modeli, Endojen Büyüme

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My family has always been there for me with their endless understanding and love. I want to express my everlasting gratitude to my parents, Gönül and Osman Voyvoda for the support they provided me on a continuous basis in my whole life. My brother İbrahim has not only been my home-mate but has also been the witness (and perhaps the victim) of stressful times during my graduate studies. I thank him for his patience and continuous support.

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To my parents Gönül and Osman Voyvoda. My first educators in life...

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Chapter 1

Introduction

This dissertation intends to study various aspects of fiscal policy alternatives for the Turkish economy. It is mainly concerned with the "real" side of the Turkish economy throughout 1990s. The primary topics of focus of this dissertation include debt dynamics, constraints on public sector deficit financing, fiscal policy attainment, and the macroeconomic interaction of the public sector with the rest of the economy. This introductory chapter outlines the questions which I address in the subsequent chapters of this dissertation following the order of evolution of analytical hypotheses.

Turkey initiated its long process of integration with the world commodity and financial markets with the initiation of the structural adjustment program of 1980. The process has been completed by the liberalization of the capital account and identification of the full convertibility of the *Turkish Lira* in 1989. As a result, during 1990s the Turkish economy has operated under the conditions of a "fully open" macroeconomy in both the current and capital accounts. However, the course of integration has not been a smooth one. The decade has been identified by volatile and erratic growth, persistent and high rates of inflation, deteriorated fiscal performance and a rapidly increasing debt burden.

A number of stabilization attempts were initiated during the decade to pull the

economy out of the traps of capricious growth and unbalanced patterns of accumulation. The IMF-supervised adjustment program known as "Turkey's Program for Transition to a Strong Economy" could be considered as the current ring of this sequence of stabilization programs. The program incorporates a wide set of measures concerning the financial sector, public sector, agriculture and social security, Nevertheless, the most emphasized goal of the program is the ensurance of the long-term sustainability of fiscal adjustment and the particular importance attributed to the regulations for "budgetary discipline". Thus, a major purpose of this dissertation is to check the viability of this program in terms of its implications on the relation of the fiscal policy with the "real" economy.

The dissertation is decomposed into two major parts. The first part is mainly concerned with debt management. The second part takes one step further to develop fiscal policy alternatives on debt management, focusing on "productive expenditures" of the public sector and the endogenous sources of growth.

Within this framework, a broad overview of the Turkish development path in integration with the global economy is given in Chapter 2. The chapter first provides a brief account of one of the major sub-periods of this path: the commodity trade liberalization and export promotion period, 1980-88. Then the main traits of the Turkish economy during 1990s, with special emphasis on the deterioration of the fiscal balances, recent relationship with the IMF, and the current stabilization program are portrayed in the remaining pages of the chapter.

Design and implementation of fiscal policies, public debt management and sustainability have received highest attention, theoretically and empirically, both in the context of developed and developing economies. The implications of the theoretical studies which are based on "infinite-lived" representative agent framework versus the

"finite-lifetimes" framework are quite diverse. Furthermore, the empirical studies often employ partial approaches, taking no account of the general equilibrium effects of the fiscal policy itself on the macroeconomy. The need for a framework that is based on a comprehensive analytical structure and that provides for simultaneous determination of the crucial variables constitutes the main motivation of this study.

I examine the macroeconomic effects of the current austerity program driven by the objective of attaining primary fiscal surpluses in Chapter 3. One of the main purposes of this chapter is to illustrate the sensitivity of the program targets to growth shocks. To do this, I utilize a model of exogenous growth in the overlapping generations (OLG) tradition with intertemporally optimizing agents and open capital markets, calibrated to the Turkish economy in 1990s. The overlapping generations framework of finite-lifetimes is based on the Modigliani and Brumberg (1954)'s "life-cycle" theory in which "rational" agents save and dissave at different stages of their lives to smooth consumption. The OLG model differentiates the life-span of the private agents from that of the government. Such a feature allows the OLG framework to study a large set of issues that the "infinite-lived" representative agent model fails to address due to the *Ricardian Equivalence* proposition. Moreover, the OLG structure intrinsically characterizes agents not only by age, but also by wealth-situation. Therefore, it is possible to study more "realistic" and "richer" patterns of production, accumulation and distribution possibilities than one finds in economies with one infinite-lived representative agent. For all these reasons, I find it appropriate to work in the framework of finite-lifetimes.

Nevertheless, the process of transformation of the analytical structure to a large-scale model under an applicable data set is rather challenging. The laborious procedure of calibration of the data set of 1990 Turkish macroeconomy to a large-scale OLG

model is illustrated in Section 3.4.2 of Chapter 3. The sections studying the fiscal debt management in the Turkish context are preceded with a brief overview of the concept of fiscal sustainability, as the term plays a central role in my foregoing analysis. I also demonstrate a simple model to study debt dynamics in this chapter.

One of the unique contributions of Chapter 3 of this dissertation is perhaps its exclusive focus on the dynamics of fiscal debt management taking account of the "general equilibrium effects" of the fiscal policies on the macroeconomy at large, through the interest rate, accumulation patterns and the interaction between the factor and product markets. Moreover it presents rigorous welfare analysis of the current and future generations that would be affected by the fiscal policy choices of the government.

Under Chapter 3 the effects of the current austerity program on the macro-environment of the Turkish economy and its vulnerability, to adverse growth shocks are investigated. Yet, no fiscal policy alternative is studied. Needless to mention further, it is important to identify the role of the public sector in the development path of the economy. Given the significant role of the government in structuring the post-1980 dynamics of the Turkish macroeconomy, I develop a model of endogenous growth to investigate the growth-consequences of fiscal debt management and financing of productive public spending in a deficit-constrained economy in Chapter 4. The emphasis of the "new" growth theory on "human capital formation" together with the large public content in education are identified so as to represent the process of "human capital accumulation" and the "endogenous growth dynamics" of the model. Such processes are designed to depend both on the accumulations of human and physical capital. Chapter 4 also includes a broad overview of human capital-driven models of endogenous growth, with special emphasis on the public involvement in the provision of education.

The model in Chapter 4 contributes to the literature of large-scale OLG models by investigating the growth and welfare effects of fiscal policies within the context of finite lifetimes. Given the implications of the theory of endogenous growth with human capital accumulation, building large-scale models with rational agents of finite-lifetimes and a government with an infinite horizon is identified as a promising avenue of research. In contrast to simple models, large-scale models enable one to consider simultaneous changes in a variety of fiscal instruments and provide ways to understand short-to-medium run responses by making it possible to observe the transition paths of the modeled economies.

Chapter 4 emphasizes the well-structured hypotheses that it is extremely important for the public sector to keep its ability to invest in accumulative factors of production, and the effects of fiscal policy on growth depend significantly on how revenue is generated and how it is spent.

Chapter 5 is reserved for the overall concluding comments and discussion on possible extensions to the model. Finally, the full algebraic set-up of a large-scale OLG model is provided in a separate Appendix.

Chapter 2

Turkey under Post-Liberalization

In this chapter, I shall provide a broad overview of the recent development path of the Turkish economy. The focus of this dissertation is mainly the fiscal policy and debt dynamics of the post-1990 Turkish economy. Yet, in order to provide a complete picture and a clear understanding of the 2000/2001 crises the review extends back to 1980. With a focus on the instruments of macro and fiscal control and the constraints of macro-equilibrium, including both domestic and foreign balances, it would be analytically more convenient to decompose the path into two major sub-periods: (i) commodity trade liberalization and export promotion period, 1980-88; and (ii) post-financial liberalization period, 1989-current. This chapter first gives a brief account of the 1980-1988 period. Then the focus will be on the main traits of the Turkish economy during 1990s, with special emphasis on the deterioration of fiscal balances, recent relationship with the IMF and the current stabilization program - the so-called "Turkey's Program for Transition to a Strong Economy".

Table 2.1 portrays the path of the major macroeconomic variables. Turkey initiated its long-process of integration with the world commodity and financial markets in 1980. Currently, the Turkish economy is operating under the conditions of a

[0]This chapter relies heavily on the paper: Metin-Özcan, Voyvoda and Yeldan (2001), "Dynamics of macroeconomic Adjustment in a Globalized Developing Economy: Growth, Accumulation and Distribution, Turkey", *Canadian Journal of Development Studies*, 22(1), 217-253.

macroeconomy that is "open" on both current and capital accounts. However, data in Table 2.1 reveal that the successive stages of integration with the world markets have been accompanied with a process of boom and bust cycles of growth and crisis. It is important to identify the transformation in many instruments of macro and fiscal control and the structural changes in the constraints of the public sector, foreign balances and the macro-equilibrium of the economy at large, that underlie such dynamics. Models in Chapter 3 and Chapter 4 of this dissertation are constructed in compliance with the main traits summarized here.

2.1 Main Features of the Commodity-Trade Liberalization and Export-Subsidization Period, 1980-1988

As the so-called *first phase of import substitution*, the 1969-79 period reached its political and economic limits with the foreign-exchange crisis of 1977-80, Turkey had to experience a regime switch on political grounds and an accompanying structural adjustment reform on economic grounds. The structural adjustment program of 1980, implemented under the auspices of the World Bank and the IMF, not only involved a short-run stabilization policy, but also incorporated the first steps of transformation of the domestic markets towards a more open economy.[1]

The main characteristics of the 1980-88 period are export promotion along with a price reform aimed at reducing the role of the state in the economic affairs and a regulated foreign exchange system with a controlled capital account. Therefore, the period 1980-88 can be marked by integration to the global markets, yet mainly through commodity trade liberalization.[2] The existing system of fixed exchange rate

[1]The assistance from IMF sources amounting to 1.63 billion U.S. dollars, had been recorded as the largest sum the Fund granted to a Third World country until then.

[2]Celasun and Rodrik (1989), Boratav and Türel (1993), Şenses (1994), Yeldan (1995), Boratav, Türel and Yeldan (1996) are among references that provide a comprehensive overview of the post-1980 Turkish structural reforms.

was replaced by a flexible regime of crawling-peg and the ceiling on interest rate of the deposit accounts was removed. The gradual but significant depreciation of *Turkish Lira*, maintenance of positive real interest rates and accompanying monetary policy all aimed higher savings, hence higher investment, promoted exports, and alleviated the need for external finance and stable macroeconomic environment.

Overall outcome of the 1980 program on the performance of the main economic indicators became perceptible with the positive rate of output growth. During the decade gross domestic product rose at an annual rate of 5.4% on average. Concomitant with the growth in output, export revenues increased at an annual rate of 15%. Nevertheless, fixed investments displayed a rather "deviating" path from the program objective. Although the gross fixed investments of the private sector increased at an annual rate of 14.4% on average during 1983-87, the rate of growth of the portion that is directed to manufacturing stayed around 7.7%.[3]

The non-compliance between the stated objectives of foreign trade towards manufacturing exports and the realized patterns of accumulation away from manufacturing is reported by many researchers as one of the main structural deficiencies of export oriented growth strategy of the 1980s.[4] The pace of generating an "exportable surplus", which could not be supported by investments, relied heavily on "wage cost reduction". The share of wage-income in manufacturing value added was reduced form 27.5% to 17% in the private sector, and from 25% to 13% in the public sector during the decade. In the meantime, share of gross profit margins in private manufacturing has increased from 31% to 38%.

[3]For a comment on the decomposition of private and public fixed investments in this period, see Yeldan (1999) and Boratav, Yeldan and Köse (2000)

[4]See Boratav et al. (2000). The authors claim that such an anomaly played a crucial role in the failure of maintaining the export-promotion program as a sustainable strategy for development and growth.

	Import-Substitutionist Industrializati 1977-80	Post-Crisis Adjustment 1981-82	Export-Led Growth 1983-87	Exhaustion 1988	Unregulated Financial Liberalizatio 1989-93	Financial Crisis 1994	Post Crisis Adjustment 1995-97	World Financial Crisis 1998	World Financial Crisis 1999	Exchage Rate-Based Disinflation Program 2000	Exchage Rate-Based Disinflation Program 2001	TSEP* 2002
Production and Accumulation (Real Annual Rate of Growth, %)												
GNP	-0.5	4.0	5.6	1.5	5.2	-6.1	7.8	3.9	-6.1	6.3	-9.5	7.8
Fixed Investment:												
Private	-7.3	-1.0	14.1	12.6	12.3	-9.1	14.0	-8.3	-17.8	15.9	-34.8	-7.2
Public	-1.7	4.8	12.0	-20.2	4.3	-34.8	13.5	13.9	-8.7	19.6	-22.0	14.5
As Ratio of GNP (%)												
Savings	17.3	17.7	19.5	27.2	21.9	23.0	21.1	22.7	19.6	19.9		
Investment	22.3	18.3	20.9	24.0	26.0	26.2	28.8	28.3	25.4	27.9	21.1	19.5
PSBR	6.9	3.7	4.7	4.8	9.1	7.9	7.2	9.2	15.3	12.0	16.2	12.4
Imports[a]	11.2	14.0	15.9	15.8	14.6	17.8	23.2	22.5	21.7	27.2	27.0	38.4
Exports[a]	4.2	8.5	10.8	12.8	9.1	13.8	15.8	13.2	14.2	13.7	20.4	26.5
Current Account Balance	-3.4	-2.7	-1.9	-1.7	-1.3	-2.0	-1.4	1.0	-0.7	-4.8	1.4	-1.0
Macroeconomic Prices												
Inflation Rate (CPI)[b]	59.5	35.1	40.7	68.8	65.1	125.5	85.0	69.7	68.8	39.0	68.5	29.7
Nominal Depreciation (TL/US $)	48.0	45.0	39.7	66.0	50.4	170.0	72.8	71.6	61.0	48.5	96.5	22.9
Real Interest Rate on GDIs[c]				-5.8	10.5	20.5	23.6	29.5	20.7	5.7	6.1	24.6

Sources: SPO Main Economic Indicators; Undersecretariat Foreign Trade and Treasury Main Economic Indicators
* Turkey's Program for Transition to a Strong Economy
a. including luggage trade after 1996
b. change in consumer prices, end of year value
c. weighted average of interest on government debt instruments

Table 2.1: Phases of Macroeconomic Adjustment in Turkey, 1977-2002

The burden of export subsidies and price incentives, together with the revaluation of foreign debt in domestic currency due to continued depreciation, led to widening of the fiscal gap of the public sector and increased reliance on foreign borrowing. In this period, major sources of disequilibria stemmed from the elevated cost of debt financing on the part of the public sector and the unbalanced structure in generating the necessary accumulation patterns for "exporting" manufacturing sectors and achieving sustained growth. The strategy of export-led growth depended on wage suppression and price incentives. However, this process reached its limits by 1988.[5] Table 2.1 exposes the stagflationary environment of 1988 when the inflation rate bursts up to 68.8% from a plateu of 40%; public investments are reduced by 20.2%; and the 12.6% rise in private investments could only make up for a -4.8% change in the investments directed to manufacturing. The output growth rate contracted to 2.1% from its annual average of 6.5% over the 1983-87 period.

2.2 Main Traits of the Financial Liberalization Period, 1989-2002

As the export-oriented growth program came to an end by 1989, real wages that had been experiencing their bottom levels during 1980s began to increase. The average growth rate of wage incomes in manufacturing was 10.2% per annum during 1989-93. Yet the profit margins did not contract at all and stayed around an average of 39.6% during the same period.

As the economy's *first phase* of integration with the global markets through commodity trade liberalization reached its limits by the adverse panorama of 1988, the initial steps of the *second phase* were invigorated.[6] These steps included administration

[5]See Yeldan (1995), (1999), Köse and Yeldan (1998a), (1998b) for thorough analysis of the ending of the classical accumulation period based on wage suppression and new mechanisms of resource shifts in the succeeding periods

[6]See Akyüz and Boratav (2002), Boratav et al. (2000), Yeldan (2002), Ertuğrul and Selçuk (2001),

of new policies towards financial market liberalization. With the elimination of controls on foreign capital and the pronouncement of the full convertibility of Turkish Lira in the world exchange markets, Turkey declared the opening of its asset markets to global financial competition.

Table 2.2 portrays the evolution of the macro-fundamentals and selected fiscal variables of the Turkish economy in the 1990s.[7] Tracing the growth rate variable from the first row of Table 2.2, one shall observe that the fluctuating behavior of the output could be attributed to this sub-period as well. Another major observation perhaps is the increase in the frequency of the mini boom and bust cycles in the last four years of the period.

The main hypothesis that this dissertation tries to maintain is that such observations are in close relationship with the deteriorating fiscal panorama of the decade. Public disposable income, which was 13.4% of GNP in 1990, eroded down to 3.9% of GNP in 2001. Meanwhile the largest item on the expenditure side was progressively observed to be the interest payments on the outstanding debt of the public sector. As a ratio to GNP, it amounted to 3.5% in 1990, and reached to 28.6% in 2002. In this regard, it is possible to assert that the central budget in Turkey has lost its instrumental role of social infrastructure development and long-term growth in the 1990s.[8]

Nevertheless, capital account liberalization served as one of the major policy initiatives in sustaining culminating fiscal deficits. Positive interest rates together with a large share of government debt instruments (GDIs) in the financial markets

Cizre-Sakallıoğlu and Yeldan (2002), Kepenek and Yentürk (2000) for extensive discussions on the post-1989 macroeconomic adjustments in Turkey.

[7] Table 4.1 of Chapter 4 provides a more detailed decomposition of government's revenue and expenditure items throughout the decade.

[8] Section 2.2.1 will elaborate more on the degeneration of fiscal balances.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Real Annual Rate of Growth (%)													
GNP	9.4	0.3	6.4	8.1	-6.1	8.0	7.1	8.3	3.9	-6.1	6.3	-9.5	7.8
Fixed Investment:													
Private	20.6	8.1	3.3	38.8	-9.6	9.8	9.2	9.7	-8.2	-17.8	15.9	-34.8	-7.2
Public	6.7	12.7	2.2	14.1	-39.5	-7.6	33.0	26.5	13.9	-8.7	19.6	-22.0	14.5
As Ratio of GNP (%)													
Public Disposable Income	13.4	11.9	11.4	9.6	9.6	9.4	7.9	9.5	8.7	7.0	7.2	3.9	6.3
Public Savings	3.4	0.7	-0.8	-2.7	-1.1	-0.1	-1.9	-1.7	-2.6	-6.8	-5.2	-9.9	-6.6
Public Investment	8.6	7.6	6.8	7.3	3.6	3.8	5.3	6.0	6.3	6.6	6.9	5.5	5.8
Budget Balance	-3.0	-5.3	-2.4	-6.7	-3.9	-4.0	-8.3	-7.6	-7.3	-11.9	-10.9	-16.2	-14.3
Public Sector Borrowing Requirement (PSBR)	7.4	10.2	10.6	12.1	7.9	5.2	8.8	7.6	9.2	15.3	12.5	16.4	12.6
Stock of Public Domestic Debt	14.6	15.5	17.8	18.0	20.7	17.5	21.3	21.8	22.2	29.6	28.9	68.5	54.2
Interest Expenditures on Domestic Debt	2.5	2.7	3.1	4.2	5.9	6.0	8.9	6.7	10.6	12.7	15.0	22.2	18.8
Stock of Public Foreign Debt	25.6	26.4	25.5	24.4	37.0	29.9	27.5	25.2	24.5	27.6	30.4	48.6	42.6
Current Account Balance	-1.7	0.2	-0.6	-3.6	2.0	-1.4	-1.3	-1.4	1.0	-0.7	-4.8	1.4	-1.0
Share in Consolidated Budget (%)													
Health	4.7	4.6	4.7	3.9	3.5	3.3	3.0	3.2	2.6	4.1	2.5	2.3	2.7
Education	13.2	14.1	14.6	14.4	11.4	10.2	7.2	8.1	8.4	7.9	7.2	6.4	7.6
Interest Payment on Debt	24.6	24.4	23.0	32.4	39.9	40.8	54.9	38.9	52.0	56.6	61.3	79.8	67.9
Macroeconomic Prices													
Real Interest Rate on GDIs[a]	1.1	16.2	15.8	18.4	19.8	19.3	33.7	25.0	29.5	20.7	5.7	6.1	24.6
Inflation Rate (CPI)[b]	60.3	66.0	70.1	66.1	106.3	93.6	80.4	85.7	69.7	68.8	39.0	68.5	29.7

Sources: SPO Main Economic Indicators; Undersecretariat Treasury

a. weighted average of interest on government debt instruments

b. change in consumer prices, end of year value

Table 2.2: Macroeconomic Indicators and Public Account, 1990-2002

necessitated large inflows of short-term foreign capital to the domestic economy. On the one hand, such inflows qualified financing of the accelerated public sector expenditures by the domestic banking system. Yet on the other hand, they resulted in the overvaluation of the domestic currency and generated widening trade deficits.

Erratic movements in the current account, a rising trade deficit (from 3.5% as a ratio to GNP in 1985-88 to 6% in 1990-93), coupled with the deterioration of the fiscal balances openly revealed the "unsustainable" nature of the growth path and at the end of 1993, the currency appreciation and the reulting current account deficit reached to unprecedented levels. Tracing the signals of vulnerability, short-term funds were suddenly removed and the economy had to contract by 6.1% in 1994. Private consumption decreased by 5.3% and inflation rate soared to 125.5%.[9] Together with the contraction, the post-1994 crisis management is observed to give rise to substantial shifts in income distribution. The real wages in manufacturing decreased by some 36.3% in this year, and the wage income share in total value added declined to 16% from its average of 21.8% during 1989-93. The substantial reduction in wage costs and the depreciation in currency enabled exports to rise in the post-crisis period.

In accordance with the saving precautions taken as a result of the stabilization program, public investments declined following the 1994 financial crisis. However, there was only a slight increase in private investments, on an order that can not be regarded as proportionate to the decline in the public investment. Public investments started to recover in 1996. Still, the increase could not be upholded because the economy started to face the adverse effects of the 1997 Asian and 1998 Russian crises.

The increasing public sector deficits, high real interest rates and the change in the mode of financing of the outstanding government debt still remain on the center

[9]For detailed analysis of the path to the crisis, see Boratav et al. (1996), Özatay (1999), Ekinci (1998), Balkan and Yeldan (1998).

of the discussion on why the data suggest very little structural change on the market concentration, pricing behavior and accumulation patterns in the post-1980 outward-orientation and post-1989 financial liberalization periods. Given this observation, the fiscal balances need further evaluation. I refer to the deterioration in fiscal balances in the next section.

2.2.1 Deterioration of the Fiscal Balances

The post-1989 period can be identified by a drastic damage on the fiscal balances in Turkey.[10] The PSBR as a ratio to GNP jumped to 10.2% in 1991, from its level of 7.4% in 1990, and continued to increase thereafter to 15.3% in 1999 and 16.4% in 2001. The last four years' average for this variable, during which Turkish economy has been under close supervision of IMF, is 14.2%. The rationale behind such an observation is that, while aggregate government revenues has increased to 24.2% in 1999 from a level of 14.2% as a ratio to GDP in 1990, the ratio of public expenditures has risen to 35.9% from its level of 17.2% in 1990. These developments have led to a sharp collapse of the disposable income of the public sector. As narrated above, public disposable income contracted by 45% in real terms during the decade. It is not difficult to deduce that such declines in income and increases in non-productive expenditures create strong pressures on the provision of "public services" which have always been the major *accomodating factor* in the economy.

In this context, it is important to note a fundamental point in time where the financing of the PSBR has undergone a major change. During the financially repressed conditions of the 1970s and early 1980s, the predominating method in financing the budget deficit was monetization. However, after the removal of the interest ceilings and

[10]For extensive analysis of the deterioration of fiscal balances in post-1990 Turkey, see San (2002), Özatay (1999), Türel (1999), Selçuk and Rantanen (1996), Atiyas (1995).

opening-up of the capital account, the financing of the deficit relied mostly on domestic borrowing through the issues of government debt instruments (GDIs). Thus, public sector's share in financial markets remained notably high during 1990s.[11]

With the aid of the higher real interest rate, the private sector adopted immediately to the new pace of financing public sector deficits. The stock of domestic debt was only 6% of the GNP in 1989, just when the liberalization of the capital account was completed. It grew rapidly, and reached to 28.9% by 1999 and to 54.8% by the end of 2002. Interest costs on debt, starting from a level of 3.5% of GNP in 1990, reached to 13.7% of the GNP in 1999, and to 28.6% in 2002. As a furher comparison, data reveal that the interest costs on servicing the debt reached to 1,010% of public investments and 481% of the transfers accruing to the social security institutions by the end of the decade.[12] Thus, the Turkish public sector has become trapped in the dictate of debt roll-over under conditions of very high interest rates. In this vein, fiscal debt management has not only acted as an income transfer mechanism but has also constrained the state's ability to act as a productive agent. The share of public investment on education in total government spending has decreased from 18.8% in 1990, to 11.8% in 1999. Given that post-secondary education is provided mainly through public schools, it becomes more urgent to study the growth effects of public's productive funding policies under the constraints of government debt management.

2.2.2 Recent Relationship with the IMF and the May 2001 Fiscal Austerity Program

Over the 1990s the Turkish macro-balances depict a picture of an economy trapped with cycles of boom and crisis at high frequency. A number of stabilization attempts during

[11] Ekinci (1998) comments on financial deepening and the state's role in the development of financial markets in Turkey.

[12] See Undersecretariat of Treasury, http://www.treasury.gov.tr

the decade were unsuccessful in pulling-out the economy from the traps of artificial growth strategies and unbalanced accumulation and distribution patterns. Affected by the crises in East Asia and Russia, Turkish economy came to a point where it was in need of intervention. Turkish authorities launched a comprehensive disinflation program in 1998, known as the "Staff-Monitored Program", with the aim of reducing inflation and improving the fiscal performance of the economy. However, the program was hit by two unfortunate earthquakes and an environment of political uncertainty so that fiscal balances worsened even further and deficit-financing requirements began to apply significant upward pressure on real interests.

Turkish government announced a new comprehensive program under the supervision of IMF, and launched a *Letter of Intent* on the 9^{th}, December of 1999. Yet, just eleven months after the announcement of the program, Turkey experienced a severe financial crisis in November 2000. The evolvement of November 2000 and February 2001 crises has been the subject of detailed analyses.[13] Therefore, I will be giving a rather chronological summary of the period here and focus more on fiscal targets of the current stabilization program.

The December 1999 program was designed as an explicit disinflation program aimed at reducing the inflation to single digits by the end of 2002. An exchange rate basket value was pre-announced for the first one and a half years and a widening band thereafter. Moreover, severe fiscal prudence towards specific targets of primary balance and privatization were among the fiscal objectives of the program.

Yet, the inertia in inflation, loosening current account balance, rising real interest rates and deterioration of banks' balance sheets were the major signs of unsustainability

[13]See Akyüz and Boratav (2002), Boratav and Yeldan (2002), Yeldan (2002), Celasun (2002), Ertuğrul and Selçuk (2001), Gençay and Selçuk (2001), Yentürk (2001), Uygur (2001), Boratav (2001), Celasun (2001) and Yeldan (2001b), (2001a).

under the program. The economy rolled into a severe financial crisis in November 2000. The short-term stability after the crisis soon turned out to be fake and the authorities had to declare the surrender of the fixed exchange rate system on 22^{nd}, February 2001. The stock markets, employment, production, finance and the *Turkish Lira* went into a downward spiral as the GNP shrunk by 9.5% over 2001, the worst performance recorded in the last fifty years

The IMF's current austerity program, hailed as "Turkey's Program for Transition to a Strong Economy" (TSEP) was first introduced in May 2001, just after the February 2001 financial crisis. It has then been expanded both in financial sector, public sector, agriculture, and social security. According to the official announcements, in order to ensure long-term sustainability of the fiscal adjustment, and to improve public sector efficiency in governance, regulations for "budgetary discipline" and "enhancement of revenue sources" have been put in charge.

In particularly, TSEP has targeted a primary fiscal surplus of 6.5% of GNP every year until 2004, and aimed at reducing the net debt stock of domestic debt to 40.96% and that of foreign debt to 40.3% as a ratio to GNP by the end of the year. By 2006, the net consolidated public debt stock[14] as a ratio to GNP is targeted to reach 63.9% from its level of 81.3% in 2002. It has foreseen a real rate of growth of 3% in 2002, and 5% for 2003 and 2004 and an operative nominal interest of 69.6% for 2002, 46% for 2003, and 32.4% for 2004. The basic macroeconomic targets of the program are summarized in Table 2.3.

[14]The *net* consolidated public debt stock can be found by substracting the deposits of the Treasury at the Central Bank and the Central's Bank's net foreign assets from the gross public debt stock.

	2001	2002	2003	2004	2005	2006
Macroeconomic Targets						
GNP Growth Rate	-8.5	3.0	5.0	5.0	5.0	5.0
Public Sector Primary Balance	5.7	6.5	6.5	6.5	6.5	6.3
Debt Stock of the Public Sector / GNP (%)	92.2	81.3	73.3	69.4	66.5	63.9
Macro-Price Targets						
Inflation	68.5	35.0	20.0	12.0	8.0	5.0
Nominal Interest rate on Domestic Debt	99.7	69.6	46.0	32.4	27.4	23.9
Ex-ante Real Interest Rate on Domestic Del	18.5	25.6	21.7	18.2	18.0	18.0

Source: http:\\wwww.treasury.gov.tr

Table 2.3: The IMF Program Targets

Chapter 3

Overlapping Generations Modeling of the Turkish Debt Dynamics under Exogenous Growth

3.1 Introduction

This chapter analyzes the issues of fiscal sustainability, one of the topics that have come to the forefront of stabilization policy in recent years, both for the "developed economies" and the "less developed countries". Given the macro-portrait of the Turkish economy in 1990s and the macro and fiscal targets of the current "Turkey's Program for Transition to a Strong Economy", it is of particular importance to discuss the fiscal sustainability and the debt burden in the Turkish context as well. Therefore, in this chapter, I examine the macroeconomic effects of the current austerity program driven by the objective of attaining primary fiscal surpluses and illustrate the sensitivity of the program targets to growth shocks.

To this end, I first introduce the economist's vision of fiscal sustainability and solvency in Section 3.2. There is a literature of considerable size and variety focusing on issues such as feasible paths for a government both from the internal and external

markets, the importance of government's choice of the distribution of the burden of taxation in defining the constraints of public borrowing, the conditions for the government to default, and the optimum rules of budgetary discipline. Yet, the theoretical and empirical work in this area seems to follow different paths. The implications of the theory and the methods employed by the empirical studies are overviewed in this section.

In the Turkish context, with an objective of attaining macroeconomic targets as set out by the current austerity program, researchers, financial institutions and government agencies carry out exercises to check for the sustainability of public debt under various macro-settings. Section 3.2.1 presents a selected set of these studies and comment on the methodology followed .

As an alternative approach, this chapter presents a "general equilibrium" model in finite-lifetimes framework. The model is utilized to analyze the dynamic general equilibrium effects of fiscal balances. The choice concerning the framework of finite-lifetimes is discussed in Section 3.2.2. Given the debate on the partial accounting exercises to check for the sustainability of public debt and the implications of fiscal policy, I present a simple two-period OLG model to show the relationship between the choice of fiscal targets and the rest of the economy.

In the remaining parts of the chapter I develop a large-scale OLG model to study the effects of fiscal policy targets of a government constrained by the debt burden, in the context of the Turkish economy. The model developed is an exogenous growth model where the growth process is characterized by a labor-augmenting technology depending on the accumulation of both effective labor and physical capital stock. The analytical structure of the model and calibration to the Turkish economy are discussed in Sections 3.4.1 and 3.4.2 respectively.

The policy analysis of Section 3.4 basically focuses on two issues: *First*, the model is calibrated to generate the approximate macroeconomic panorama of 1990s for the Turkish economy. I then study the specifics and the expected macroeconomic consequences of the current austerity program, TSEP, as implemented under close IMF supervision. The distinguishing characteristic of the simulation is the attainment of primary surplus targets as set out in the official TSEP and the consecutive Letter of Intent documents that followed. *Next*, I try to view the path of the model economy under various growth shocks, focusing on macro variables such as production, investment and growth as well as economic welfare across generations.

The results suggest that the current fiscal program based on the primary surplus objective succeeds in constraining the explosive dynamics of debt accumulation, and yet, the path of aggregate public debt as a ratio to GNP displays significant degree of inertia and could be brought down only gradually and slowly. Furthermore, our results also suggest that the macroeconomic performance of the program is quite vulnerable to growth/productivity shocks.

3.2 Economist's Vision of Fiscal Sustainability and Solvency

Fiscal policy, sustainability and solvency have come to forefront of stabilization policy analysis in recent years. There is a vast literature, of both theoretical and empirical studies that investigate whether a given level of debt is "sustainable" and/or whether large and persistent deficits will lead a government to default, both in the contexts of developed and developing economies.[1]

[1]Among the recent studies that analyze fiscal sustainability in U.S are Flavin and Hamilton (1985), Wilcox (1989), Trehan and Walsh (1991), and Hakkio and Rush (1991). Corsetti and Roubini (1991), and Chalk and Hemming (2000) focus on fiscal sustainability in the OECD economies and come up with mixed results. After the much-debated 'Growth Pact' and 'The Maastricht Treaty' fixing maximum reference values for deficit (3% of GDP) and the net public debt (60% of GDP), the budget discipline in Europe has been a matter of increasing concern. See Buti, Franco and Ongena

However, the term "fiscal sustainability" remains highly controversial and this controversy reveals itself in much of the empirical studies where each one develops its own *indicator of sustainability*, independent of a theoretical framework. The common motivation and foci, used in most of the empirical policy analyses are the following: (i) to use a non-increasing government debt as a benchmark to distinguish sustainable fiscal policies from those that are not, (ii) to characterize a fiscal policy as "sustainable" if the path of the debt stock/GDP ratio is bounded from above, i.e. does not grow without limit, (iii) to define a fiscal policy by a simple budgetary discipline and austerity.

The theoretical literature emphasizes the intertemporal budget constraint as well as the flow budget constraint of the government and focuses on whether the current fiscal policy can be continued into the distant future without threatening government solvency. A "sustainable" fiscal policy then is the one that is expected to generate path for the debt stock and deficit such that the government satisfies both the flow-budget constraint of the current period and the intertemporal budget constraint. Given its current debt position the government remains "solvent" as long as it is possible to find at least one "sustainable" fiscal policy. If the value of the current debt stock does not allow one to find any sustainable fiscal policy, the government is no longer solvent and "defaulting" becomes inevitable. So, "solvency" differs from "sustainability" in the sense that the analysis of solvency would have to consider all conceivable government policies whereas analysis of sustainability focuses on the current fiscal policy.[2]

Simply, the analytical dimension starts with a current period flow budget

(1998). The sustainability of the fiscal policy as well as the government solvency in the Less Developed Countries (LDC's) have, not suprisingly, received the highest attention from both the academia and the internationl organizations as the IMF and the World Bank. A few to mention among are Buiter and Patel (1992) on India, Gerson and Nellor (1997) on Phillippines and Bascard and Razin (1997) on Indonesia and Agénor (2001) on Ghana and Turkey.

[2]A solvency test asks whether there is a feasible policy that would satisfy the present value of the budget constraint (PVBC), given the current value of debt. Sustainability tests are tests for the *current* fiscal policy, as reflected in the historical time series data on government spending, revenue, deficit and debt.

constraint of the government. Abstracting from monetary considerations, for a closed economy the current-period flow-budget constraint of the government is:

$$B_{t+1} = (1 + r_t)B_t + D_t \tag{3.1}$$

where B_t is the current period outstanding debt stock, r_t is the real interest rate, and D_t is the deficit (current period expenditures, net of current period revenues of the government). Solving Equation 3.1 under the forward-looking behavior:

$$B_t = -\sum_{j=0}^{\infty} \frac{1}{\prod_{k=0}^{j}(1 + r_{t+j})} D_{t+j} + \lim_{T\to\infty} \frac{1}{\prod_{k=0}^{T}(1 + r_{t+k})} B_{t+T+1} \tag{3.2}$$

According to Equation 3.2, it is possible that the government rolls over its debt each period in full, borrowing continuously to cover both the principal and interest payments. Under these conditions, the present value of the terminal debt stock becomes positive. However, in an economy with finite number of agents, the only way for the government to run a "Ponzi debt scheme"[3] is that at least one of the agents runs a "Ponzi credit scheme". But this would violate the necessary *Transversality condition* for the lender's optimization problem. So, a government attempting to play a Ponzi-game will find no "rational" individual willing to hold its liabilities. Therefore, together with the Transversality condition, which indicates that the limit in the second term of Equation 3.2 tends to zero at infinity, the government's intertemporal budget constraint should satisfy the condition that the value of the current stock of debt is equal to the present value of future primary surpluses:[4]

$$B_t = -\sum_{j=0}^{\infty} \frac{1}{\prod_{k=0}^{j}(1 + r_{t+k})} D_{t+j} \tag{3.3}$$

[3]According to Buiter and Kletzer (1998) the conventional definition of "Ponzi finance" describes a government which after some date, never runs a primary (non-interest) surplus despite having a positive stock of debt outstanding. Equivalently, the value of the additional debt issued each period is at least as large as the interest payments made on the debt outstanding at the beginning of that period

[4]See e.g. McCallum (1984), O'Connell and Zeldes (1988), Obstfeld and Rogoff (1996). However, the analogy cannot always be carried into a framework of an economy with the agents having finite lifetimes. We point to the existence of feasible debt strategies which allows for Ponzi finance under the OLG setup later in this section.

Empirical literature testing the PVBC concentrates on the time-series properties of the current fiscal policy variables such as the primary balance, debt, government expenditures and taxation, and tests whether maintenance of the current fiscal policy threatens government solvency.[5] However, econometric methods implemented in this procedure are often heavily dependent on long time series data over an *unchanging* fiscal regime, which is hard to observe, especially for developing countries.

Moreover, given the analytical properties of the PVBC, policy implications derived from such econometric work often turn out to be quite impractical. The PVBC does not rule out either large deficits or high debt to GDP ratios; it simply constrains the government debt to grow no faster than the real interest rate in the economy. So, for example for a growing economy with a relatively low level of interest rate, the debt ratio could tend to zero asymptotically, but could still be regarded as "unsustainable". Furthermore, under the constraints of the PVBC, a government cannot run a small deficit followed by primary balance thereafter since such an action would be inconsistent with the Transversality condition. Besides, there are far too many ways in which fiscal policies can comply with a budget constraint encompassing infinite periods, and for practical purposes, the PVBC approach turn out to be not that useful. Therefore, in order to be able to derive policy implications, researchers are often led to follow simpler and pragmatic approaches to confront the fiscal sustainability issue.

Rather than using demanding time-series econometrics, one method relies mostly on practical indicators, and usually sets a constant debt to GDP ratio as a benchmark state for sustainable fiscal policies. It is usually the primary deficit (surplus) that is used as the key variable indicating a sustainable fiscal policy if it generates a constant, rather than ever increasing debt to GDP ratios, given the real interest rate and the

[5] In that sense, given the historical time series on government spending, revenue and debt, and given the current fiscal policy stance, testing for the PVBC should be regarded as a test for "sustainability".

growth rate of the economy. For its exclusive reliance on a limited set of macroeconomic indicators, this method is referred as the "accounting approach".

More formally, if $Dy_t = D_t/Y_t$, the primary deficit (surplus) to GDP ratio, "the primary gap indicator" by Blanchard (1990), is based on the definition of permanent deficit (surplus) to GDP ratio ($\bar{Dy}$) needed to stabilize the debt to GDP ratio, $By_t = B_t/Y_t$:

$$\bar{Dy} = (\varphi_t - r_t)By_t \tag{3.4}$$

where φ_t denotes the growth rate of the economy. The primary gap indicator is then,

$$\bar{Dy} - Dy_t = (\varphi_t - r_t)By_t - Dy_t \tag{3.5}$$

of which a negative value suggests that the current primary deficit is "too large" to stabilize the debt ratio, thus fiscal policy is regarded as unsustainable.

The primary deficit (surplus) to GDP ratio, Dy_t is not the only type of indicator used, and the constancy of the debt ratio is not considered as the sole definition of sustainability, either. Depending on whether the emphasis is on government expenditures or on government revenues, different indicators of sustainability are used. In one such instance, Buiter (1985) argues that a sustainable fiscal policy should keep the public sector net worth to output ratio constant at its current level. He then calculates the primary deficit to achieve this objective. Blanchard (1990), in turn, proposes the application of a "tax gap indicator" along with the primary deficit indicator where he calculates a "permanent revenues to GDP ratio" ($\bar{Ty} = T_t/Y_t$) so that debt to output ratio would be stabilized, i.e.

$$\bar{Ty} = Gy_t - (\varphi - r_t)By_t \tag{3.6}$$

where Gy_t is the government non-interest expenditures to output ratio. The "tax-gap

indicator" is:

$$Ty_t - t\bar{Y} = Ty_t + (\varphi - r_t)By_t - Gy_t \tag{3.7}$$

of which a negative value, suggests that current taxes are too low to stabilize the debt ratio, given the current spending policies.

Blanchard also suggests a "medium-term tax gap indicator", as the difference between the current tax ratio and the tax ratio that is necessary to stabilize the debt ratio over the next N years, under the assumption of constant rates of growth and real interest rates. The "debt-stabilizing tax ratio" is then given by:[6]

$$\bar{Ty} = \frac{1}{N}\sum_{j=0}^{N}(Gy_{t+j} - (\varphi_{t+j} - r_{t+j})By_{t+j}) \tag{3.8}$$

$$= \frac{1}{N}\sum_{j=0}^{N}(Gy_{t+j} - (\varphi_t - r_t)By_t) \tag{3.9}$$

The accounting approach has also been used to check policy consistency among various macroeconomic targets. For a government having a constant debt/GDP ratio (By^*), a GDP growth rate (φ^*) and a primary surplus/GDP ratio (Dy^*), as policy targets, it is possible to check mutual consistency among them.[7]

In its broader version of the accounting approach, that is claimed to be followed by the IMF, it is asked whether a fiscal policy is sustainable, and if not, what type of an adjustment is to be taken. Accordingly, the following steps are taken sequentially:[8] (i) Based on the macro-data of the country under consideration, a projection with a five-year horizon is made assuming that the current fiscal policy is continued. This is regarded as the benchmark scenario. (ii) From this projection, debt dynamics is

[6]Note that such a forward-looking calculation requires a projection of future spending. The indicator measures how much the tax ratio needs to rise over the next N years to stabilize the debt ratio given the current and expected future spending policies.

[7]See R.Anand and Wijnbergen (1989). Yet, in checking consistency using accounting approach, the typical assumption is that the primary surplus will have no effect on either the real interest rate or the GDP growth rate, which is quite partial and abstract.

[8]See e.g. Chalk and Hemming (2000), Agénor and Montiel (1999). The IMF's official programming model, known as the Polak Model, has recently celebrated its 40^{th} year. See Polak (1997).

generated and then the sustainability is assessed. (iii) If debt dynamics is indicated as "unsustainable", an alternative scenario is proposed, making necessary corrections on fiscal variables which will typically define a "stable path" over the medium term. Attention is usually on the adjustment of primary balance required to meet the debt ratio target and the fiscal measures that can generate this adjustment. IMF's approach is similar to that of Blanchard's primary-gap indicator approach, but it measures the necessary amount of medium-term adjustment that is given by a vector of primary adjustments for years t to $t+i$, $\left\{Dy_{t+j} - \bar{Dy}_{t+j}\right\}_{j=0}^{i}$ for some debt ratio to be stabilized at some point i in the future.[9]

IMF also claims that it pays considerable attention to the external sustainability as well. With a methodology followed in analogy to the fiscal sustainability approach, the necessary condition for external sustainability is that a country's net foreign liabilities cannot grow faster than the foreign interest rate:[10]

$$\lim_{T\to\infty} \frac{1}{\prod_{k=0}^{j}(1+r_{t+k}^{w})er_{t+j}} B_{t+T+1}^{F} = 0 \tag{3.10}$$

where ${r_t}^w$ is the world interest rate and er_t is the average annual real exchange rate. B_t^F denotes the net foreign liabilities, where, given the real exchange rate and the trade balance, TB_t, the following equation holds:

$$er_{t+1}B_{t+1}^{F} = (1+r_t^w)er_tB_t^F - TB_t \tag{3.11}$$

In theory, there is no clear linkage between the fiscal and external sustainability. However, starting from the national income identity, it is possible to reach:

$$er_tB_t^F = B_t + \sum_{j=0}^{\infty} \frac{1}{\prod_{k=0}^{j}(1+r_{t+k})}(S_{t+j}^{P} - I_{t+j}) \tag{3.12}$$

[9]Note that there is no unique vector of primary adjustments. IMF's strong preference is for an adjustment path that is front-loaded. International Monetary Fund (1996), portrays a typical application of the whole procedure for G-7 countries.

[10]For empirical tests on external sustainability see, Trehan and Walsh (1991), Husted (1992) and Ahmed and Rogers (1995).

where S_t^P is private savings and I_t is private investment in period t. Equation 3.12 states that if net foreign liabilities are greater than the government debt, there has to be an excess of private savings over private investment (in present value terms) to cover the future external debt services.

In its simplest form, for an economy with sustainable external position, and yet, unsustainable fiscal policy, the Equation 3.12 above will become:

$$er_t B_t^F = B_t + \sum_{j=0}^{\infty} \frac{1}{\prod_{k=0}^{j}(1+r_{t+k})}(S_{t+j}^P - I_{t+j}) - \lim_{T\to\infty} \frac{1}{\prod_{k=0}^{T}(1+r_{t+k})} B_{t+T+1} \quad (3.13)$$

which indicates that government is financing its deficit by using domestic debt. In this case, if the current fiscal policy is not changed, the government will inevitably default on the domestic debt service.

3.2.1 Applications to Turkish Fiscal Policy Environment

In the Turkish context, given the macroeconomic targets stated in Section 2.2.2, it has been a routine exercise to "check" the sustainability of the Turkish fiscal position by conducting various combinations of growth, real interest rate, and primary surplus. In a recent study, Akçay, Alper and Özmucur (2002) investigate the relationship between fiscal sustainability, inflation and budget deficits. They use three definitions for public debt, the face value, the market value and the discounted market value, and conjecture that a necessary and sufficient condition for fiscal sustainability in Turkey is that the debt/GDP ratio series be stationary. Their findings indicate that under each of the three definitions, the debt/GDP ratio is non-stationary and integrated of order 1.

Agénor (2001) first points to large public sector borrowing requirements during 1990s in Turkey. Then, using the data from International Monetary Fund (2000) for Turkey, he reports that within an output growth rate of 5%, a real interest rate of 12%, and an inflation rate of 5%, a primary surplus of 3.5% to GNP would be needed

to stabilize the debt to GNP ratio at 60%. Based on the counter-factual scenarios, Agénor further reports that an additional 1 percentage point of primary surplus would be needed for each 2 percentage points of higher real interest rates.[11]

More recently, Keyder (2003) carries out a similar exercise. Using detailed fiscal data, Keyder follows the methodology suggested by World Bank (2000), where she finds the primary surplus/GDP ratio needed to keep the net debt stock to GDP ratio constant under different combinations of the growth rate, inflation rate and the real interest rate. Keyder reports that Turkey's debt would come out to be "sustainable" on condition that the real interest rate is reduced to 15% or less. However, with an inflation rate of 20%, and a real interest rate of 20%, even at a 7% GNP growth rate, the primary surplus/GNP ratio needed for sustainability jumps to 8.1%. Noting that at the time of her writing (March, 2003), the weighted average of the real interest rate was around 25%, Keyder recommends strict continuation of the austerity program.

In addition to the studies mentioned, various financial institutions and rating agencies carry out similar exercises almost on a monthly basis, in their close monitoring of the Turkish fiscal stance. Under such exercises, various combinations of real interest rates, output growth rates and inflation rates are contrasted against a "plausible" benchmark scenario, and the resultant debt/GNP ratios are reported (International Monetary Fund (2000), World Bank (2000), Under Secretariat of Treasury (2003)).

The crucial critique on these accounting exercises is that such studies take no account of the general equilibrium effects of the fiscal policy itself on the macroeconomy

[11] Agénor points to the limitations of such an exercising framework: (i) the a priori presumption that a sustainable fiscal policy should maintain the debt to GNP ratio constant is arbitrary, (ii) base-year ratio may not represent a sustainable debt burden, but a much lesser optimal one, (iii) the framework lacks a simultaneous determination of the primary balance, the growth rate of output, and the real interest rate. This may seriously distort the simulation results, (iv) intertemporal considerations are absent in the sense that the consistency framework is static focusing on the flow budget constraint, whereas the government budget also has an intertemporal dimension; finally, (v) the lender's role is not explicitly.

at large, through interest rates, output, the saving-investment gap and the current account balance. To analyze such effects, one would ideally use a macro-economic model of a consistent system of simultaneous equations that explicitly relates these fiscal policy variables to (presumably) endogenous variables such as the real interest rate, wages, production, private and public expenditures on consumption and investment, and the foreign trade.

3.2.2 Fiscal Sustainability in Finite-Lifetimes Framework

It is most probably the nature of the representative agent model that divorces the destiny of the real economy from the activities of the government through the Ricardian Equivalence proposition. The fundamental reason for this proposition, which is about the equivalence of government borrowing and (lump-sum) taxation alternatives of financing government expenditures, is that the life-span of both the government and the individual agents are the same. Therefore, the choice of the type and timing of fiscal policies do not affect the incidence of agents' burden. However, things change substantially when it is possible to model the economy in a framework where the identity of the individuals that draw the benefits (of a tax cut for example) is different than the ones who bear the cost. The overlapping generations framework, based on the seminal work of Diamond (1965) offers an environment where the choices of the alternative fiscal policy patterns effect the burden, and therefore, alter the distribution of welfare across generations.

The distinction between an economic model with identical, infinite-lived agents, in which the government budget simply becomes the mirror image of the individual budgets, and a model where government lives longer than individual agents implies different implications for fiscal sustainability. The duration of the time dimension is especially relevant in answering questions such as: What are the feasible paths

for a government that is borrowing both internally and externally? In what sense government's ability to borrow is limited by its capacity to tax? Can a government keep re-financing a debt in perpetuity, issuing new liabilities to repay maturing debt, or must it eventually default? Must the government budget be in balance over time, the surplus in good times canceling out the deficit of adverse years? Is it possible for an infinitely living government to play a *rational Ponzi game*?[12]

As my discussion on the settlement of the PVBC indicates, the answer is rather simple in an economy populated by identical, infinite-lived agents. The *Transversality condition* in such an economy rules out the competitive equilibria with permanent deficits; how small they may be, the government has to satisfy the PVBC.

Permanent government deficits are fairly easier to visualize in economies with a more *realistic* demographic structure, in which the state is possibly infinite-lived but individuals are not. The characterization of rational Ponzi games are given in the prominent study of O'Connell and Zeldes (1988). According to O'Connell and Zeldes, the existence of rational Ponzi games depend on two sets of conditions. The first set is related with some key characteristics (such as the real interest rate, population growth rate, growth in per-capita income) of the economy whose agents hold the debt. The second set of conditions state that the lenders of the economy at all points of time must be willing to hold the outstanding debt. In discussing the possibility of rational Ponzi games, O'Connell and Zeldes emphasize each agent satisfying its own Transversality condition as the key point of their analysis. They show that if the interest income is not taxed,[13] Ponzi finance is only possible in deterministic, competitive, perfect-foresight OLG models, if the economy is in a dynamically Pareto inefficient

[12] A government can play a *rational Ponzi game* when Ponzi finance is among the feasible strategies of the government.

[13] Sustainability of permanent primary deficits with capital taxation is analyzed by Uhlig (1997).

equilibrium.[14] O'Connell and Zeldes conclude that, in the case of external debt for example, the conditions in the borrowing economy are irrelevant to the feasibility of Ponzi game equilibria. However, in case the Ponzi finance is feasible, the ability to repay debt (creditworthness) increases the chances for the borrower to roll-over its debt perpetually, without having to default.

However, apart from legal, administrative and political restrictions, that would possibly constrain the government both in reality and in theory, there are restrictions on a government's ability to play *rational Ponzi games* under the assumption of finite-lived individuals as well. First, the government is restricted by the aggregate endowment of the economy within which it operates. Secondly, as all revenue-raising devices have distortionary side-effects on the allocation of resources, moving the "fiscal sustainability" analysis away from the "accounting approach" to a general equilibrium framework, would indeed necessitate the analysis of government's "capacity to tax"[15] and the private sector's "capacity to lend". Therefore attempts to raise public debt, therefore, if carried beyond a certain point, would put strong pressure on the interest rates to destroy competitive equilibrium: the requirement of debt service will grow with a rate higher than the society's lending capacity of an economy in *finite-time*. Buiter and Kletzer (1998) show that in order to convincingly discuss the issues like government's ability to borrow and feasible Ponzi-finance schemes, one requires careful specification of the government's "capacity to tax", that is the richness of the set of lump sum and/or distortionary tax and transfer instruments available to it.

[14] In an OLG model with two-period lived (young, old) individuals, Buiter and Kletzer (1998) show that "weak" Ponzi finance, in which the government issues transfer to one or both generations alive in any one period and does not raise *aggregate* taxes or reduce *aggregate* transfer payments in any period, may be feasible whether or not the competitive equilibrium is dynamically efficient, and regardless of the long-run relationship between the interest rate and the output growth rate.

[15] Note that an agents can always pay for higher taxation out of her higher interest earnings, so output does not put a pressure on the government to raise the tax revenue in the standard infinite-lived individual model.

Buiter and Kletzer also provide a characterization of feasible fiscal-financial plans, by showing that there are both lower and upper bounds on the public debt in each period, together with the requirement that exhaustive public spending cannot be negative and cannot exceed the total physical resources available in any period.

The most direct attempt to determine the theoretically maximum level of sustainable government debt using an OLG model is by Rankin and Roffia (1999).[16] With the conjecture that incentives to default for a government increase as the debt stock increases, Rankin and Roffia use a closed-economy model in which the share of tax burden between the young and old generations is taken as given, and consider the *real* effects of government debt. Their contribution is that, there is a possibility that even with a constant debt stock, the fiscal policy may well be unsustainable because the steady-state of the economy with "non-degenerate" values of the variables may not exist. The practical implication of such a result would be that in an economy where debt is gradually ratcheted-up, the government has to monitor the level of debt carefully because it may not receive any obvious warning that the limit is about to be reached.[17]

Marin (2000) presents an OLG model in which the PVBC of the government is replaced by a rule of budgetary discipline (which is indeed the one imposed by the 'Stability and Growth Pact', criteria of the European Union (EU)).[18] The paper emphasizes the use of nominal budget balance targets to GDP ratios, and estimate adjustments needed as a function of the observed values of debt and deficit ratios. Marin's prediction is that the EU rules of budgetary discipline ensure governments'

[16]Excellent pedagogic examples can be found in Azariadis (1993) and Sargent (1987).

[17]The authors describe this situation as "catastrophe" and show that such a state is indeed a catastrophe in mathematical terms. The variables remain in the interior of their *economically meaningful* ranges but nevertheless, a steady state suddenly ceases to exist.

[18]Such a rule guarantees the global stability of equilibrium and make sustainability and stabilization measures compatible.

solvency and satisfaction of the PVBC.

Given the discussion on debt sustainability and the constraints on government fiscal policy in the framework of finite-lifetimes, a simple model to illustrate the dynamics of the economy is constructed. The next section presents this simple analytical model to show the relationship between the government debt and the real economy to "sustain" it.

3.3 A Simple OLG Model to Study Debt Sustainability

Here, I construct a simple model to discuss analytically the interaction between the fiscal policy variables, debt, deficits, government revenues and the rest of the economy in the context of finite lifetimes.

The economy is supposed to start out its evolution with a given amount of capital per-worker k_0, and with some initial debt stock b_0 of national debt per-worker. Each member of initial old generation is assumed to be endowed with e_0 units of effective labor. All outstanding government debt is assumed to mature in a period. The fiscal authority is assumed to follow a fiscal policy, such that it collects tax revenues (from the wage-earners) to keep the total debt stock ratio to output at some targeted level By, given its policy on expenditures as a ratio to output, Gy. Given the effects of the fiscal policy on household decisions, internal consistency of the targeted levels of debt and public expenditures are analyzed. Thus, the focus of the model is to show the interaction between the public and the private sectors, and the resulting dynamics of the production and distribution.

Households

Consider an overlapping generations economy where individuals live for two periods, and a new generation is born every period. Denote the number of people born to the economy at time t by n_t. The life-time utility derived from the consumption of an agent belonging to generation t (the generation born at time t) is represented by the function:

$$U_t(c_{1,t}, c_{2,t+1}) = u(c_{1,t}) + \frac{1}{(1+\rho)} u(c_{2,t+1}) \tag{3.14}$$

with $u(c) = \frac{c^{1-\gamma}}{1-\gamma}$ and $\gamma > 0$, where $c_{1,t}$ and $c_{2,t+1}$ denote the young and old period consumption of a person born in period t, respectively. Note that $u(c) = ln\, c$ when $\gamma = 1$. Using this specification:

$$U_t(c_{1,t}, c_{2,t+1}) = ln(c_{1,t}) + \frac{1}{1+\rho} ln(c_{2,t+1})$$

Agents work in the first period of their lives (when they are young) and are considered as retired in the second period (when they are old). Labor supply is inelastic on the part of every young individual. Each young individual is endowed with e_t units of effectiveness per each unit of labor, l_t it supplies. For simplicity I assume $l_t = 1$. The wage rate per unit of effective labor is represented by w_t and the interest rate by r_t. The government sets a proportional tax τ_t, each period on the labor income.[19]

The budget constraint for a young agent at time t is:

$$c_{1,t} + s_t = (1 - \tau_t) w_t e_t \tag{3.15}$$

Similarly, the agent's budget constraint when she is old at time $t+1$ is :

$$c_{2,t+1} = (1 + r_{t+1}) s_t \tag{3.16}$$

[19]I choose labor income to keep the analysis as simple as possible. The capital income taxation brings additional complexity to the model. However, it should be noted that the government policy on the distribution of the burden of taxation between young and old generations has a significance in the analysis.

Here, s_t is the savings of the agent when young at time t.

Maximization of the utility function subject to the constraints (3.15) and (3.16) and $(c_{1,t}, c_{2,t+1}) \geq 0$ yields the following first order condition:

$$c_{2,t+1} = \left(\frac{1 + r_{t+1}}{1 + \rho}\right) c_{1,t} \tag{3.17}$$

The life-time budget constraint of a young individual at time t is:

$$c_{1,t} + \frac{1}{(1 + r_{t+1})} c_{2,t+1} = (1 - \tau_t) w_t e_t \tag{3.18}$$

Plugging Equation (3.17) into Equation (3.18), we get the following expressions for the consumption and savings behavior of an agent born at time t:

$$c_{1,t} = \left(\frac{1 + \rho}{2 + \rho}\right) (1 - \tau_t) w_t e_t \tag{3.19}$$

$$s_t = \left(\frac{1 - \tau_t}{2 + \rho}\right) w_t e_t \tag{3.20}$$

Production

The representative firm of the economy produces output Y_t according to the technology,

$$Y_t = A K_t^{\alpha} L_t^{1-\alpha} \tag{3.21}$$

where K_t and L_t denote the amount of total physical capital and the total effective labor at time t, respectively. $L_t = e_t n_t$. α is the capital income share and $0 < \alpha < 1$.

Profit maximization of the firm yields:

$$r_t = \alpha A K_t^{\alpha - 1} L_t^{1-\alpha} \tag{3.22}$$

$$w_t = (1 - \alpha) A K_t^{\alpha} L_t^{-\alpha} \tag{3.23}$$

Government

The government finances the flow of public sector spending G_t at time t by tax revenues and newly issued public debt. Thus, government's budget constraint is:

$$B_{t+1} = (1 + r_t)B_t + G_t - T_t \tag{3.24}$$

where B_t is the stock of public debt at time t. T_t denotes the tax revenues and since all taxes are collected from the wage income of the young individuals, is equal to, $T_t = \tau_t(w_t e_t n_t)$.

Government Policy

Let the government's fiscal policy be such that G_t/Y_t with $Gy \in (0, 1)$ and B_t/Y_t with $By \in (0, 1)$ are constants. That is, the government tries to keep the debt stock ratio to total output constant, given its expenditures/output ratio. Let $Gy = G_t/Y_t \ \ \forall t$ and $By = B_t/Y_t \ \ \forall t$. [20] Then, the government's budget constraint will be:

$$ByY_{t+1} = (1 + r_t)ByY_t + GyY_t - T_t \tag{3.25}$$

Now, for simplicity, assume that there is no technological improvement in the labor input ($e_t = e_0 \ \ \forall t$) and no population growth ($n_t = \bar{n} \ \ \forall t$).[21] Then, Equation (3.25) will look like:

$$ByAK_{t+1}^{\alpha}(\bar{n}e_0)^{1-\alpha} = (1+r_t)ByAK_t^{\alpha}(\bar{n}e_0)^{1-\alpha} + GyAK_{t+1}^{\alpha}(\bar{n}e_0)^{1-\alpha} - \tau_t w_t(\bar{n}e_o) \tag{3.25$'$}$$

It is now possible to compute the tax rate on wage income, τ_t, for each period t, that allows the government to continue the fiscal policy it announces:

[20] The choice of a fiscal policy that is dependent on the output each period makes it possible to study the dynamics of the economy in a scalar system with the variable capital stock.

[21] At any possible steady-state then the variables of the model will be all constants, i.e. the growth rate of the economy at the steady state will be zero. However, the qualitative results would not change with any positive growth rate as long as a labor-augmenting exogenous growth process is assumed.

$$\tau_t = \frac{(1+r_t)ByAk_t^{\alpha}e_0^{-\alpha} - ByAk_{t+1}^{\alpha}e_0^{-\alpha} + GyAk_t^{\alpha}e_0^{-\alpha}}{w_t} \tag{3.26}$$

where $k_t = K_t/\bar{n}$, physical capital stock per labor in the economy.

Equilibrium

Given k_0, b_0 and e_0, an equilibrium of the economy modeled is defined as a sequence of allocations $\{K_t, L_t, Y_t, B_t, G_t, c_{1,t}, c_{2,t+1}, \tau_t\}_{t=0}^{\infty}$ and prices $\{w_t, r_t\}_{t=0}^{\infty}$ such that:

(i) given w_t and r_{t+1} the allocation $(c_{1,t}, c_{2,t+1})$ solves the problem of the representative agent of generation t.

(ii) given w_t and r_t allocation (Y_t, K_t, L_t) maximizes the representative firm's profits subject to the production technology.

(iii) $L_t = \bar{n}e_0 \quad \forall t$

(iv) τ_t is such that $B_t = ByY_t$ and $G_t = GyY_t \quad \forall t$

(v) $K_{t+1} + B_{t+1} = \bar{n}s_t$

Using the two first order conditions for profit maximization of the representative firm, the tax rate τ_t every period is calculated as a function of (k_t, k_{t+1}):

$$\tau_t = \frac{Byk_t^{\alpha} + \alpha ByAk_t^{2\alpha-1}e_0^{1-\alpha} - Byk_{t+1}^{\alpha} + Gyk_t^{\alpha}}{(1-\alpha)k_t^{\alpha}} \tag{3.27}$$

The goods market equilibrium condition (v) can be written in per-capita terms and using the expression of s_t from Equation (3.20):

$$\begin{aligned} k_{t+1} + b_{t+1} &= s_t \\ &= \frac{(1-\tau_t)}{(2+\rho)}(1-\alpha)Ak_t^{\alpha}e_0^{1-\alpha} \end{aligned}$$

Substituting the value of τ_t, needed for the government to continue its fiscal policy from Equation (3.27), we get:

$$(2+\rho)k_{t+1} + (1+\rho)b_{t+1} = (1-\alpha)Ak_t^{\alpha}e_0^{1-\alpha} - b_t(1+\alpha Ak_t^{\alpha-1}e_0^{1-\alpha}) - g_t \qquad (3.28)$$

where $g_t = G_t/\bar{n}$, government spending per labor. The government's fiscal policy implies that $b_t = ByAk_t^{\alpha}e_0^{1-\alpha}$ and $g_t = GyAk_t^{\alpha}e_0^{1-\alpha}$. Substituting these two expressions in Equation (3.28), we get:

$$(2+\rho)k_{t+1} + [(1+\rho)ByAe_0^{1-\alpha}]k_{t+1}^{\alpha} = (1-\alpha-By-Gy)Ae_0^{1-\alpha}k_t^{\alpha} - \alpha ByA^2(e_0^{1-\alpha})^2k_t^{2\alpha-1} \qquad (3.29)$$

Equation 3.29 characterizes the path of the path of the capital per-labor k_t of the economy, given the fiscal policy on targeted total debt stock to output ratio, By and government (non-interest) expenditures to output ratio, Gy.

Before studying the dynamics of an economy starting from an initial point, I shall investigate the steady-state behavior. As there is no exogenous technological progress, in the steady-state, the variables will be at their stationary values (which I indicate by dropping the time-subscripts). The steady-state version of Equation 3.29 is:

$$k^{2\alpha-1}[(2+\rho)k^{2(1-\alpha)} + [(2+\rho)By + Gy - (1-\alpha)]Ae_0^{1-\alpha}k^{1-\alpha} + \alpha ByA^2(e_0^{1-\alpha})^2] = 0 \quad (3.30)$$

$k = 0$ is definitely a steady state for the model economy. The part of Equation 3.30 in parentheses is a second-order equation in $k^{1-\alpha}$, and the solution of the equation yields two different values of steady-state capital per-labor (k_1, k_2), for each pair of plausibly chosen (By, Gy) pair:

$$k_{1,2}^{1-\alpha} = \frac{(1-\alpha-Gy-(2+\rho)By) \mp \left\{[(2+\rho)By + Gy - (1-\alpha)]^2 - 4\alpha(2+\rho)By\right\}^{1/2}}{\frac{2(2+\rho)}{Ae_0^{1-\alpha}}} \qquad (3.31)$$

For any steady state capital per-labor that is different than zero to exist, the term in in Equation 3.31 has to be greater than or equal to zero. That is, the choice of (By, Gy) has to be such that:

$$[(2+\rho)By + Gy - (1-\alpha)]^2 \geq 4\alpha(2+\rho)By$$

Moreover, if the relationship holds at equality, $k_1 = k_2$. In fact, given the choice for Gy, it turns out that the level of By that causes $k_1 = k_2$, is the maximum level of debt/output ratio that can be sustained by the economy at the steady-state.

Suppose that the condition in Equation 3.3 holds with strict inequality. Further investigation of the Equation 3.31 reveals that for a steady state with positive capital per-labor to exist, the labor income share $1-\alpha$ should be large enough to support the chosen values of By and Gy. That is, the condition

$$(1-\alpha) - Gy - (2+\rho)By > 0 \tag{3.32}$$

should hold.[22] In this case, we have both roots of Equation 3.30 are positive with $k_1 < k_2$.

Given Gy, the graphical representation of the steady-state capital per-labor, k and the debt-stock/output ratio, By illustrates clearly the analysis this far. Equation 3.30 is plotted in Figure 3.1.

The most important result of the analysis is that a maximum level of sustainable steady-state debt to output ratio exists. It is impossible for the policy maker to target a level of By that is greater than By^m and sustain the situation. Moreover, the value of the maximum sustainable debt to output ratio is clearly dependent on the choice of Gy. As the targeted level of government expenditures/output ratio increases, the

[22] Coupled with Equation 3.3, the condition in Equation 3.32 reduces to $(1-\alpha) - Gy - (2+\rho)By > 2[\alpha(2+\rho)By]^{1/2} > 0$.

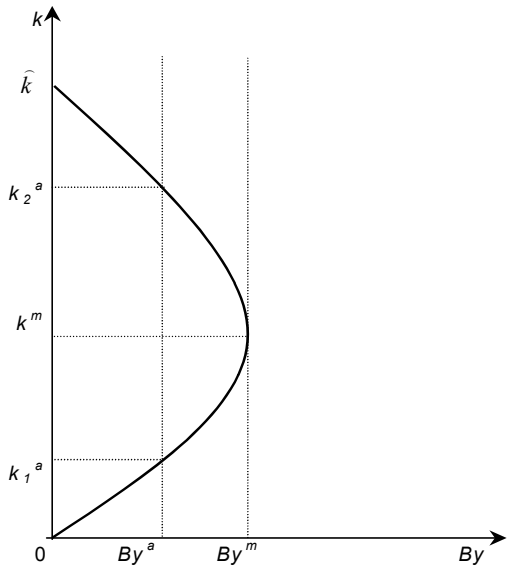

Figure 3.1: Relationship between By and k in the "feasible" region

maximum sustainable level of debt/output ratio By^m is reduced. Moreover, given a feasible choice for By, an increase in the choice of Gy decreases the (stable) level of k.

Given the characterization of the steady state under the fiscal policy defined, consisting of a particular type of government spending instrument (choice of Gy) and a particular type of government debt instrument (choice of By), it is possible to derive the dynamic path for an economy starting from some initial level of capital per-labor, k_o. Figure 3.2 illustrates the steady-state $k's$ under a plausible choice of (By, Gy) and the direction of movement for the economy contingent on the initial capital/labor ratio k_o.

The phase diagram in Figure 3.2 depicts the two steady states that we have calculated for given values of $By > 0$ and $Gy > 0$. The steady-state with a lower k (k_1) is "unstable" and the steady state defined with a higher level of k (k_2) is the "stable" steady state. As By is raised, The distance between the origin and k_1 increases and the distance between the origin and k_2 decreases. So, the region of initial values moving the economy towards the "stable" steady-state with a positive value of k, (k_1, ∞) shrinks.

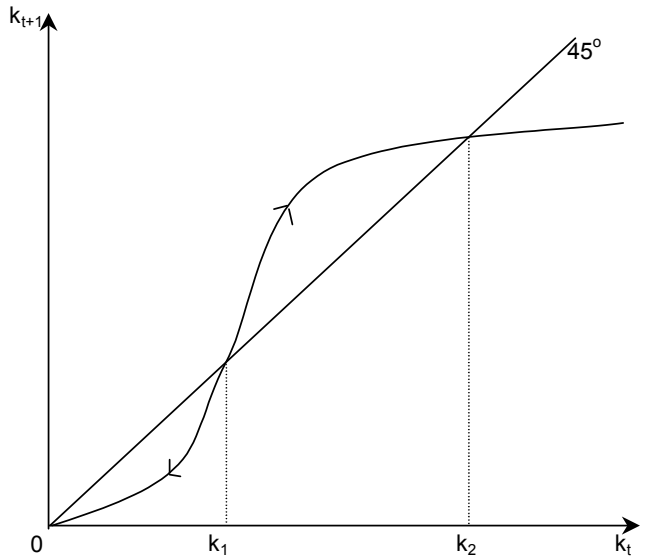

Figure 3.2: Dynamics of an economy under feasible choices of (By, Gy)

Hence, higher choice of the level of By increases the probability of "poverty traps" for the economy.

The simple model of this section has illustrated how the choice of fiscal policies affect the dynamics and the steady-state properties of the economy described. Under the assumption of finite-lifetimes, it is not only the growth rate of the debt stock that matters, but also its level. However, increasing the life-length of each individual, it is possible to obtain a model of a more "realistic" set-up and use it as a laboratory device to study the effects of various shocks on the economy. In the remaining pages of this chapter, I develop a large-scale exogenous growth OLG model to analyze the effects of growth shocks to the macro-environment, focusing on the variables such as the fiscal balances, real output, accumulation, factor prices, the external policy, and social welfare over time.

3.4 Managing Turkish Debt

Chapter 2 of this dissertation briefly portrays the phases of macroeconomic adjustment in Turkey starting with the introduction of the post-1980 structural adjustment program. After periods of volatile and erratic growth, characterized by persistent high inflation, a deteriorated fiscal performance and rapidly increasing debt burden, often identified by continuous crises, Turkey is currently following the IMF-led austerity program called "Turkey's Program for Transition to a Strong Economy" (TSEP). The measures that the program involves are stated in Section 2.2.2 of Chapter 2 (see Table 2.3). Yet, given the fragile position of the Turkish public sector, many researchers and financial rating agencies conducted a series of programming exercises to monitor the fiscal sustainability and debt burden in the short-to-medium run. However, such exercises are often restricted to a partial adjustment framework, and do not go beyond an accounting check between the real rate of growth of GNP, the interest rate, and debt to GNP ratio. In fact, what is perhaps most notably lacking in these exercises is a general equilibrium framework where all macroeconomic variables are resolved in a consistent (Walrasian) system of flow equations describing production, expenditures on consumption and investment both by the public and the private sectors, savings and asset accumulation, and the fiscal balances together with debt dynamics.

In this chapter, I develop a large-scale, small open economy model of exogenous growth with a government constrained by the dynamics of debt servicing. The model developed has an overlapping generations structure with 30 generations at any moment, optimally choosing lifetime consumption and saving patterns. The growth process is characterized by a labor-augmenting technology.

The model is calibrated to Turkish economy through 1990s. The aim in utilizing such a model of the Turkish economy is to examine the macroeconomic effects of the

current austerity program driven by the objective of attaining primary fiscal surpluses and to illustrate the sensitivity of the program to growth shocks and to borrowing constraints. In this regard, to provide an explicit check for sustainability is not the main objective of this study.[23] Rather, given the significant level of the current debt stock, and given the macroeconomic targets, this study provides a comprehensive set-up to analyze the general equilibrium effects of the fiscal policy on the macroeconomy at large. The general equilibrium framework allows for construction of the restrictions on the government's debt policy. Therefore, it is possible to analyze the effects of the level and the growth rate of the debt stock on the economy.

In the next section, the general analytical structure of the model is introduced. Next, I describe the methodology followed in calibrating a large-scale OLG model to the Turkish economy. The chapter proceeds with the analysis of macroeconomic effects of the current austerity program driven by the objective of attaining primary fiscal surpluses and illustrate the sensitivity of the program targets to growth shocks.

3.4.1 Algebraic Structure of an Exogenous Growth OLG Model

The model is based on Modigliani and Brumberg (1954)'s "life-cycle" theory. Agents save and dissave at different stages of their lives to smooth consumption. So, the OLG structure characterizes generations not only by their age but also by their wealth endowment. In each period, agents will be at different stages of their life-time planning, and therefore, will be affected differently by any policy action taken by the government.

As growth process is defined exogenously in this section, the model can be viewed

[23]There are already a number of studies that "check" for the sustainability of the current fiscal position of Turkey by using various definitions of sustainability as discussed in Section 3.2.1. The model constructed in this chapter does not involve an exogenous condition for sustainability. Given the characterization of fiscal sustainability in finite-lifetimes framework (see Section 3.2.2) the study here provides the path of debt stock of the economy, which may well be used as an input to carry out "sustainability" exercises under various definitions.

as a version of Auerbach and Kotlikoff (1987) and Hviding and Mérette (1998). The economy consists of overlapping generations of finite-lived individuals who are assumed to have GL periods to live, starting from the time they enter the workforce. During the first GW periods, each individual works, receives an exogenous wage income and profits, which she divides between consumption, tax payments on labor and capital incomes, and savings. In the last $(GL-GW)$ periods, the agent is retired and consumes her accumulation of assets. Hence, at any point in time, there are GL overlapping generations in the economy, GW working and $(GL - GW)$ retired. Households are assumed rational, having perfect foresight.

There is a single commodity, produced under a neo-classical technology using capital and *effective* labor. Output is either used-up by domestic households or exported. Government generates revenues through taxation of both types of factor incomes, issues debt and administers public expenditures.

Financing of the loanable funds for capital accumulation is secured by a "financial" intermediary. The intermediary collects domestic and foreign savings, as well as the interest payments on previously issued government debt, and the rental on accumulated stock of physical capital in production, and disposes off its aggregate funds among, (i)new physical capital accumulation, (ii)interest payments to domestic residents and abroad, (iii)the public sector borrowing requirement. The intermediary has neither an independent objective function nor any incentives for positive profits; it simply acts as a means of collecting and re-distributing the loanable funds of the economy.

The algebraic structure of the model can be separated into several sets of equations relating to the household behavior, production sector, government, intermediary, foreign sector, and aggregation and equilibrium conditions. I discuss

each group in turn.[24]

Households

In what follows, subscript t stands for the time period and subscript gl stands for the age-group.

At any date t, $n_{1,t}$ individuals enter the workforce of the economy. Following the common practice, I will work with a representative agent for each of the GL generations. Each individual, once entered into the workforce derives utility from consuming $cc_{gl,t}$ units of consumption commodity while living her gl^{th} age at time t.[25]

An agent, entering the workforce at time t, is assumed to have an additively-separable form of intertemporal utility function:

$$U_t(cc_{1,t}, cc_{2,t+1}, ..., cc_{GL,t+GL-1} = \sum_{gl=1}^{GL} \beta^{gl-1} u(cc_{gl,t+gl-1}) \tag{3.33}$$

with the discount factor $\beta \in (0,1)$. $u : \Re_+ \rightarrow \Re$ is the current-period utility function.[26] Leisure is not an argument of the utility function given the assumption of inelastic labor supply.

The optimization problem of the representative agent entering the workforce in period t is to maximize the intertemporal utility function in Equation 3.33, choosing life-time consumption $\{c_{gl,t+gl-1}\}_{gl=1}^{GL}$ and saving $\{s_{gl,t+gl-1}\}_{gl=1}^{GL}$ paths subject to the following constraints:

$$\begin{aligned} s_{gl,t+gl-1} &= (1-\tau_{i,t+gl-1})[(1-\tau_{w,t+gl-1}) z_{gl} e_{gl,t+gl-1} w_{t+gl-1} + \\ &\quad (1-\tau_{r,t+gl-1}) r_{t+gl-1} a_{gl,t+gl-1}] - c_{gl,t+gl-1} \end{aligned} \tag{3.34}$$

[24]The full set of equations for this model is given in Appendix A

[25]The childhood period is assumed to bring no utility to the agent and no burden to parents. There are no bequest motives in the model.

[26]The current-period utility function, $u(.)$ is continuously differentiable, strictly increasing, strictly concave and *homothetic*. The homotheticity of u allows for a balanced growth path under the labor-augmenting technology. See Caballé (1998).

$$
\begin{aligned}
a_{gl+1,t+gl} &= a_{gl,t+gl-1} + s_{gl,t+gl-1} && (3.35)\\
a_{GL,t+GL-1} &= -s_{GL,t+GL-1} && (3.36)\\
c_{gl,t+gl-1}, a_{gl,t+gl-1} &\geq 0\\
a_{1,t} &= 0
\end{aligned}
$$

Equation 3.34 represents the allocation of disposable income between consumption and savings each period. $s_{gl,t}$ is the savings of an agent of age group gl in period t. z_{gl} is an indicator for working generations that are eligible to wage earnings:

$$
\begin{aligned}
z_{gl} &= 1 \quad \text{if} \quad gl \leq GW\\
&= 0 \quad \text{if} \quad GW \leq gl \leq GL
\end{aligned}
$$

Each working agent earns an effective wage rate w_t for each unit of effective labor she supplies. $e_{gl,t}$ represents the technology level "embodied" in the age-group g. r_t is the interest rate and $\tau_{i,t}$, $\tau_{w,t}$, $\tau_{r,t}$ are tax rates on gross income, wage income, and capital income, respectively. Equation 3.35 is the physical wealth accumulation condition for the agent, where $a_{gl,t}$ is the physical wealth asset holdings of an individual of age g at time t. Every agent enters the workforce with zero level of initial assets and consumes all her wealth, the interest earnings and the principal in the last period of her life, leaving no bequests.

The solution to the consumer's maximization problem leads to the following first order condition for an interior solution:

$$
\frac{\partial u(cc_{gl,t+gl-1})}{\partial cc_{gl,t+gl-1}} = \beta(1 + (1 - \tau_{r,t+gl-1})r_{t+gl-1})\frac{\partial u(cc_{gl+1,t+gl})}{\partial cc_{gl+1,t+gl}} \qquad (3.37)
$$

As we specify an exogenous improvement which leads to a "labor-augmenting"

technology, we impose the condition that every generation entering the workforce has a higher stock of technological knowledge then the previous one and thus, becomes more productive by a constant factor φ:

$$e_{1,t} = (1 + \varphi)e_{1,t-1} \tag{3.38}$$

An agent, once endowed with the technological know-how, maintains her abilities throughout her life-span. With the effective wage rate w_t, an agent of age group gl earns aggregate labor income of $w_t e_{gl,t}$ at time t for every $gl \in \{1, 2, ..., GW\}$.

Production Sector

Firms face competitive output and input markets to maximize profits. Non-negative quantities of the two factors of production, effective labor and physical capital can be varied costlessly. All firms are identical, therefore it is possible to symbolize the production sector by a representative firm, under the assumptions of neo-classical production technology. The representative firm's production function exhibits non-increasing returns to scale in both factors of production, is strictly concave, twice continuously differentiable, and satisfies the *Inada conditions*. No depreciation is assumed on the part of physical capital.

In order to facilitate the analytical exposition of the production sector, I assume that the function $F(K, L)$ captures the above (neo-classical) properties of the production technology. Thus,

$$Y_t = F(K_t, L_t) \tag{3.39}$$

where K_t is the aggregate physical capital and L_t is the stock of effective labor. In equilibrium, L_t is derived by aggregation of each agent's labor-embodied technological factor(e) multiplied by the number of workers belonging that particular generation (gl)

over the working generations (GW):

$$L_t = \sum_{gl=1}^{GW} e_{gl,t} n_{gl,t} \tag{3.40}$$

where $n_{gl,t}$ is the population of age group gl at time t.

Hence, factor demands, resulting from the profit-maximization decision of the firm are determined by the two first order conditions:

$$r_t = \frac{\partial F(K_t, L_t)}{\partial K_t} \tag{3.41}$$

$$w_t = \frac{\partial F(K_t, L_t)}{\partial L_t} \tag{3.42}$$

Government

In the current model, the analysis is focused on government spending behavior and accumulation of debt. It is hypothesized that the government spends on its administrative expenditures, levies taxes on both types of income, pays interest on its already accumulated debt stock, and borrows to finance any excess of its current spending over its current revenues. It is further assumed that the government's only debt instrument is one-period bonds that pay the current interest and principal in the next period. Government's flow budget constraint is then of the form:

$$B_{t+1} = (1 + r_t)B_t + G_t - T_t \tag{3.43}$$

where B_t is the outstanding government debt, G_t is the government's total expenditures and T_t is the total tax revenues. It is assumed that the government has no other income than what it collects through general taxes, distributes no transfers, and does not invest in physical capital accumulation.[27] Tax income of the government is defined

[27] A more detailed analysis of the government sector including social security issues would incorporate transfer payments as well. I resort to the specification that the government is not investing to avoid making ad-hoc assumptions regarding public sector's investment decisions.

as a function of proportional taxes on disposable income $\tau_{i,t}$, labor income $\tau_{w,t}$ and capital income $\tau_{r,t}$:

$$\begin{aligned} T_t &= \tau_{i,t}\left[\sum_{gl=1}^{GW}(1-\tau_{w,t})w_t e_{gl,t}n_{gl,t} + \sum_{gl=1}^{GL}(1-\tau_{r,t})r_t a_{gl,t}n_{gl,t}\right] \\ &+ \tau_{w,t}\sum_{gl=1}^{GW} w_t e_{gl,t}n_{gl,t} + \tau_{r,t}\sum_{gl=1}^{GL} r_t a_{gl,t}n_{gl,t} \end{aligned} \tag{3.44}$$

Intermediary

All expenditure on capital accumulation are mediated through an artificial borrowing-lending structure called *the intermediary*. It simply acts as an accounting identity which accumulates loanable funds in the economy:

$$RI_t = S_t^P + r_t B_t + r_t K_t + S_t^F \tag{3.45}$$

where S_t^P and S_t^F represent the aggregate savings by domestic residents and foreigners, respectively. The amount $r_t B_t$ is the interest earnings of the intermediary on current debt of the government, and $r_t K_t$ is the rental earnings on capital stock used in production.[28]

The intermediary disposes off its funds, EI_t, on the interest payments for servicing domestic and foreign lenders, on investment demand for physical capital, and on purchases of newly issued government debt:

$$EI_t = I_t + r_t A_t + r_t BI_t^F + D_t \tag{3.46}$$

In Equation 3.46, $A_t = \sum_{gl} a_{gl,t}$ represents the aggregate stock of assets in the economy, held by domestic residents. $I_t = K_{t+1} - K_t$ is the gross investment in physical capital in period t. $D_t = B_{t+1} - B_t$, current period government deficit. BI_t^F, likewise, is the foreign debt of the intermediary. As I assume no speculative arbitrage gains

[28]The deterministic set-up of the model avoids to model any risk-premium or arbitrage on government debt. The interest rate of the model is equal to the marginal product of capital.

through operations of the intermediary in the deterministic set-up of the model, it is also assumed that the net profits of the intermediary are zero.

Under the current set-up, each period, government deficit D_t is financed by newly issued bonds, whose only buyer is the intermediary. The intermediary then, itself creates a market for both the domestic and foreign savings.[29] Equation 3.46 narrates the crowding out effects of the government debt instruments (GDIs) in the loanable funds market. Under the assumption of perfect substitutability for all assets in the economy, the newly issued debt directly constrains the amount of funds available for private investment in physical capital.

Thus, if we represent the portion of government debt financed by the asset accumulations of domestic residents by BI_t^D, the following identity arises:

$$BI_t^D + BI_t^F = B_t \qquad \forall t \tag{3.47}$$

Foreign Trade

The model, under the assumption of small-open economy, regards world prices (PW_t) of imports and exports as exogenously given. Based on the idea of distinguishing commodities by place of production (Armington (1969)), the consumers' intertemporal allocation problem is stated in terms of a composite good, CC, which is composed of the domestically produced good (DC) and imports: (M).[30]

$$CC = \Omega(DC, M) \tag{3.48}$$

where Ω is a linearly homogeneous function.

The notion of substitutability among goods of different origin also carries over to production, and the production frontier for domestic sales and exports can be expressed

[29]This should not be considered as a secondary market though, under the assumption of zero profit level for the intermediary.

[30]For the analytical treatment of a similar idea of individuals' intertemporal optimization when consumption spending includes non-tradables and tradables, see Obstfeld and Rogoff (1996).

as:

$$Y = \Delta(DC, E) \tag{3.49}$$

where Y is the total output produced in the economy.

Aggregation and Equilibrium Conditions

In order to ensure that the model is logically consistent and is in equilibrium, the following conditions are introduced:

Resource constraint on the physical capital stock requires that the sum of aggregate physical capital and the stock of government debt be equal to the sum of private wealth and foreign debt, each period:[31]

$$K_t + B_t = \sum_{gl} a_{gl,t} + BI_t^F \tag{3.50}$$

Since in each period, the sum of physical investments equals to additions to the aggregate capital stock, Equation 3.50 shows how, in equilibrium, the debt servicing requirement by the government constrains the economy's capacity to generate investments, therefore capital accumulation and real growth.

Finally, we have the typical resource constraint for the small-open economy:

$$K_{t+1} - K_t = Y_{t+1} - CP_t - r_t B_t^F + B_{t+1}^F - B_t^F \tag{3.51}$$

where $CP_t = \sum_{gl} cc_{gl,t} n_{gl,t}$, the aggregate private consumption.

In this model, the *steady state* is a perpetual general equilibrium where all real values grow at a constant rate. More formally, we have a steady state in the economy when (i) perfect foresight consumers decide on their savings supply and consumption demand by intertemporal optimization over their utility function

[31]The Equation 3.50 expressed in "stock" variables can also be expressed in "flow" variables by equating the revenues and expenditures of the intermediary indicated in Equations 3.45 and 3.46.

(Equation 3.33) subject to the constraints (Equations 3.34, 3.35, 3.36), (ii) firms take the factor prices as given, and derive their factor demands and output supplies by profit maximization, satisfying the Equations 3.41, 3.42 (iii) the government flow budget constraint (Equation 3.43) is satisfied, (iv) resource equilibrium and accounting conditions are satisfied (Equations 3.40, 3.47, 3.50, 3.51), (v) the level of foreign trade variables are determined in accordance with the Equations 3.48, 3.49, (vi) effective wage rate w_t and the profit rate r_t become stationary, and (vii) levels of flow and stock variables grow at the constant steady state growth rate, given by the exogenous rate of labor-augmented technological change, φ.

3.4.2 Policy Analysis

Calibration of the Model-Cohort Behavior

In this section, I shall describe the calibration of the model, to generate the approximate panaroma of the Turkish economy at the end of 1990s. First, the general methodology followed in calibrating the OLG model, focusing especially on the cohort behavior is described. Then the specification of functional forms and choice of parameters are presented.

Large-scale models undoubtedly offer a more realistic setup than the simple model described in Section 3.3, and allow for the enhancement of the income effects associated with the fiscal policy changes. Such a framework also allows to analyze quantitatively the transition path from one balanced growth path to another. However, such a model does not lend itself to analytical treatment and, under the assumption of perfect foresight, all equations ought to be solved simultaneously.

Following the construction of the data set for the model economy, the general methodology followed in the large-scale modeling framework is to "calibrate" the model

economy to approximately represent the "real economy" that is studied, the Turkish economy in this case. The calibration exercise basically enables one to get values of the structural parameters of the algebraic equations describing the model by using the data set produced, assuming a steady-state equilibrium. Then the calibrated parameters are expected to reproduce the data set as a "solution" to the model. Thus, we first calibrate the model to a macroeconomic data set which is considered as the relative equilibrium of the Turkish economy.[32] We then generate a baseline simulation path, that will serve as a "benchmark" where policy alternatives and exogenous shocks are to be compared.

Auerbach and Kotlikoff (1987), Chapter 4 serves as the main reference for the calibration of a large-scale overlapping generations model. The basic difference in the calibration procedure of a model in OLG tradition from a representative agent model is generation of an "equilibrium path" rather than an "equilibrium point" as a benchmark. The calibrated parameters then are expected to produce the equilibrium path both vertically in time and horizontally across generations. In their study, Auerbach and Kotlikoff obtain the initial solution using an iterative technique, referred in the literature as Gauss-Seidel method. The algorithm start with guesses of a subset of endogenous variables like the aggregate capital stock, K_t, total labor supply, L_t, wage income and tax rates to calculate the wage rate and the interest rate that are consistent with factor supplies. Then, they combine the calculated interest rate and the wage rate with the "guessed" variables to solve for the optimal household behavior. Decisions of the households that result indicate whether *aggregated* values of the capital stock and the labor supply are consistent with initial guesses. If not, the aggregated values constitute a "new" starting point for the recursive algorithm described. Auerbach and Kotlikoff report that typically 10-20 iterations are required to achieve a convergence to

[32]The choice of the "base-year" in this initial "fitting" procedure is crucial. Since an "equilibrium path" is assumed, the base-year should not be a point of"structural break" or coincide with a period of "high-frequency" business cycles.

a solution for the initial steady state.

The calibration methodology applied in this study follows a similar logic with that of Auerbach and Kottlikoff. But, different from their iterative procedure which starts with the initial guesses of aggregate variables, and then passes on to the analysis of optimal household behavior, the methodology followed in this study starts with the behavior of a representative household. Assume that this household enters the workforce at time t, which coincides with the initial-year t_0 of which the data is used while constructing the initial steady-state. This particular representative agent making life-time consumption and saving decisions starting from period t_0 until period $t_0 + GL$ is marked by "*". Note that this agent's life-span is on the diagonal of the sub-matrix staring with the cell $(t_0, 1)$ and ending with the cell $(t_0 + GL - 1, GL)$ in Figure 3.3.

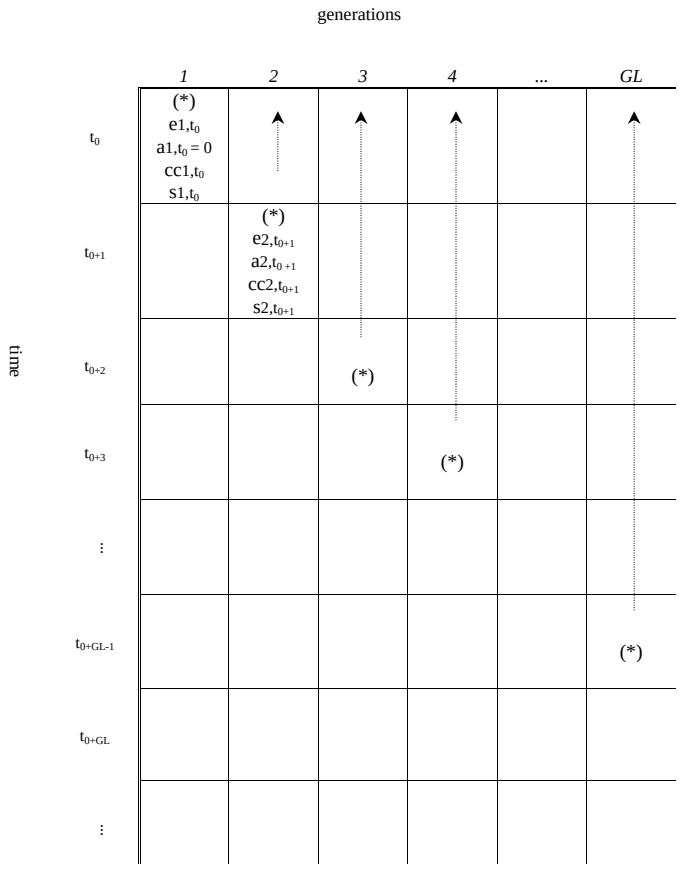

Figure 3.3: Generational Structure of the Economy

The intertemporal optimization problem of this representative agent is already described in Section 3.4.1. So, under the assumption of perfect foresight and *exogenous* steady-state growth rate, it is possible to extract the life-time consumption and savings behavior of this particular agent as functions of the parameters, the wage rate and the interest rate. But typically, all agents that are alive in the initial period of the economy, t_0, have been following the same "pattern" of life-time decisions. So, under the assumption of steady-state, it is possible to obtain the consumption and asset holding profiles of each age-group ($gl \in \{1, 2, 3...GL\}$) by a backward projection of the behavior of the representative agent entering the workforce at time t_0. This procedure is schematized by back-arrows in Figure 3.3. Now, it becomes possible to calibrate the "behavioral parameters" of the model using the observed values of the GNP, total private consumption, aggregate labor supply, and the amount of government debt that is financed by aggregate asset holdings of the domestic households from the initial year data set, t_0. The methodology also allows for generation of some of the demand-side and supply-side parameters of the model (like the discount rate and the technology scale parameter) using the *observed* values of the aggregate variables of the initial year. Nevertheless, for some of the parameters of the model, I still had to rely on estimations from other empirical studies.

Formally, every sub-system of non-linear equations in the calibration procedure has been constructed as a square system. The system then is solved by using the PATH solver of the *General Algebraic Modeling Solver* (GAMS).[33]

[33]PATH solver of GAMS is an implementation of a "stabilized Newton method", a modification of the well-known "Newton's method" to ensure global convergence. The basic idea of the method is to construct a local approximation of the non-linear system around a given point x^k via linearization. The "Newton point" x^N is the unique zero of this approximation. The next iterate in the "Newton process" is determined by a search along a "Newton direction" d^k.

Model Specifications

In this section, I specify the functional forms that are calibrated to the model described in Section 3.4.1.

In this section, the economy is envisaged as consisting of overlapping generations with a life-span of 30 periods. ($GL = 30$), 24 working ($GW = 24$), and 6 retired. Thus, assuming that every agent enters the workforce at the age of 16, retires at the age of 64 and lives until the age 76, $gl = 1$ refers to age group 16-17 years old, and $gl = 30$ refers to age group 74-75 years old. Throughout the policy exercises, population growth rate is assumed zero, keeping the population of each generation constant at some $n_t = \bar{n}$ for all (gl, t), which is computed using the aggregate number of workers of the initial year.[34]

The current period utility function $u(.)$ is assumed to be of *Constant Elasticity of Substitution* (CES) type:

$$u(cc_{gl,t}) = \frac{1}{1 - \frac{1}{\gamma}} cc_{gl,t}^{1-\frac{1}{\gamma}}$$

where γ is the intertemporal elasticity of substitution. Under this specification, differentiation of the utility function with respect to $cc_{gl,t}$ subject to individual's lifetime budget constraint, yields the following first-order condition for an interior solution:

$$cc_{gl+1,t+gl} = [\beta(1 + (1 - \tau_{r,t+gl})r_{t+gl}]^{\gamma} \, cc_{gl,t+gl-1} \qquad gl = 1, 2, ...29$$

The economy's production technology is represented by a Cobb-Douglas production function, with physical capital and effective labor force used as primary inputs:

$$Y_t = AK_t^{\alpha} L_t^{1-\alpha}$$

[34]The choice of constant number of workers each period brings a degree of computable simplicity but avoids formulating any questions on the effects of the population growth rate. The assumption does not alter the results qualitatively but one should be careful in their quantitative interpretation.

with $L_t = \sum_{gl=1}^{24} e_{gl,t}\bar{n}$.

A, the technology scale parameter and α the capital income share are the two calibrated parameters of the above equation. Under this specification, the effective wage rate w_t and interest rate r_t are given by the following equations:

$$\begin{aligned} w_t &= (1-\alpha)AK_t^{\alpha}L_t^{-\alpha} \\ r_t &= \alpha AK_t^{\alpha-1}L_t^{1-\alpha} \end{aligned}$$

Under the assumption of small-open economy, domestic imports and exports are derived through the "Armingtonian" specification based on the idea of Armington (1969), which distinguishes the commodities not only by their sector, but also by their place of production. Armingtonian specification is traditional in the computable general equilibrium framework. Following this specification, the domestic commodity (DC), imports (M) and exports (E) are differentiated from each other by means of imperfect substitutability. Thus, product differentiation in this context is specified by functions of constant elasticity of substitution and transformation:

$$\begin{aligned} CC_t &= ac\,(bc\,M_t^{-\nu} + (1-bc)DC_t^{-\nu})^{(-1/\nu)} \\ Y_t &= at\,(bt\,E_t^{\mu} + (1-bt)DC_t^{\mu})^{(1/\mu)} \end{aligned}$$

Given the relative price imported and domestically produced good, cost-minimizing amount of imports, M_t each period satisfies:

$$\frac{M_t}{DC_t} = \left(\frac{bc}{1-bc}\right)^{\sigma_m}\left(\frac{PD_t}{PW_t}\right)^{\sigma_m}$$

Similarly, faced with a relative export-domestic good price ratio, the producer maximizes revenues at the export allocation E_t relative to DC_t by:

$$\frac{E_t}{DC_t} = \left(\frac{1-bt}{bt}\right)^{\sigma_e}\left(\frac{PW_t}{PD_t}\right)^{\sigma_e}$$

Choice of Parameter Values and Solving for the Base-year Quantities

As noticed above, the first step of calibration consists of fitting the "steady-state" version of the model with the Turkish data. As narrated in Chapter 2, Turkey has completed its financial liberalization by 1989 and since then, both the government's mode of meeting its borrowing requirements and financing of the external (current account) deficits have gone through profound changes. So the year 1990 stands as the best candidate to serve as the initial year in fitting the steady-state version of the model. By 1990, the economy's full integration with the global markets had been completed and the economy had not entered the high-frequency boom and bust cycles yet. Thus, in this step, I use the database set out and discussed in detail in Köse and Yeldan (1996) and Yeldan (1998), and calibrate the "structural" parameters of the model. With the calibrated parameters, the model has to generate the data of the initial year 1990, as a solution for a point in the equilibrium path of the economy. The consumption and the accumulation patterns of a typical representative agent is also reproduced in this step. Given that it is possible to generate information on the consumption and asset accumulation behavior of each age group, the behavioral parameters of households are produced. The calibrated and assumed values of the taste and technology parameters are reported in Table 3.1.

The calibration strategy that is followed at this stage basically takes some of the aggregate supply and demand-side values from the data set (such as output, aggregate private consumption, interest payments on public debt) and determines the parameters which satisfy all the equilibrium and accounting conditions of the model. The model is calibrated with a given amount of foreign debt at this initial steady-state growth path.[35]

[35] As Buiter (1981) shows, current account deficit is possible along a balanced growth path in a one-good OLG model.

Parameters and Initial Values, Stage 1	
Number of generations, *GL*	30
Number of working generations, *GW*	24
Technology scale parameter, *A*	0.4534
Capital income share, α	0.495
Household discount factor, β	0.9775
Intertemporal elasticity of substitution, γ	2.00
Exogenous technological growth rate, φ	0.03
Interest rate, *r*	0.0935
Income tax rate, τ_i	0.1271
Wage Income tax rate, τ_w	0.0764
Parameters and Initial Values, Stage 2	
Wage rate, *w*	0.5987
CES function shift parameter, *ac*	1.8989
"" *bc*	0.4091
CES function share parameter, *v*	-0.70
CET function shift parameter, *at*	1.9962
"" *bt*	0.6780
CET function share parameter, μ	1.50
Debt stock ratio to GNP, *B/Y*	0.8258
Domestic debt stock ratio to GNP, B^D/Y	0.48
Foreign savings ratio to GNP, S^F/Y	0.0804

Table 3.1: Calibration Results - Exogenous Growth Model

Using 1990 capital income and labor income data, the capital share parameter α is calibrated. Here, the rate of productivity growth in the labor-augmenting production function is taken to be 3% per period.[36] The real interest rate is determined endogenously and is equal to the marginal product of capital. The profile of consumption and asset holdings of each generation is generated consistent with the aggregate output and aggregate private consumption figures of 1990. The key parameter to satisfy this consistency is the rate of time preference of private households β which took the value of 0.9775. The elasticity of substitution parameter γ is taken from Auerbach and Kotlikoff (1987). The stock of government domestic debt and total physical capital were calibrated using data on "total asset accumulation by domestic household" and the "interest payments on domestic debt". Finally, the tax rates on

[36] 3% represents the average productivity growth, net of population growth for the 1990s.

both types of income are calibrated using the total tax payment figures of 1990.

The second step in producing the benchmark economy is to bring the economy to the base-period (representing 2002-2003 in the model). To be able to reproduce the historically realized trajectory of the macroeconomic variables, the public sector balances in particular, the model is shocked by imposing the realized increase in public consumption expenditures over the decade.[37] As the base-period is reached, the variables and parameters underlying the debt structure of the economy are calibrated. It is now possible to calibrate the parameters that underlie the demand for foreign savings and the stock of foreign debt (shift and share parameters in the Armingtonian commodity specification) as the base-period is reached. The ratio of exports to GNP in the base-period is used as an input at this step of the calibration procedure.

The base-period value of total debt stock to GNP is 83.3%. The domestic debt constitutes 57.6% of this sum, while the rest is the foreign debt stock. Once the composition of government debt is known, it is easy to generate the amount of foriegn savings needed to finance the base-period current account deficit. Given the export/GNP ratio of the base-period, I calibrate the value of the iport demand from the accounting identity that states the value of import demand as the amount of total domestic absorption net of domestically produced, unexported good.

In the last stage of the calibration, I study the specifics and the expected macroeconomic consequences of the current austerity program, TSEP, as implemented under close IMF supervision.

[37]Because I assume no public investment, the variable under consideration at this step is the government expenditures in each period, generating the path of the government debt stock through 1990s

3.4.3 Primary Surplus Program

The distinguishing characteristic of the simulation is the attainment of primary surplus targets as set out during the official implementation of the program. Given the focus of the current austerity program on attaining significant fiscal surpluses on the non-interest budget, I will distinguish this scenario as the "Primary Surplus Program" (PSP). This scenario will further serve as a benchmark simulation path against which I shall ask and compare the results of our "what if" questions. In line with the official targets outlined in Section 2.2.2 above, the model is utilized to create a permissible level of government expenditures (net of interest payments) to create a pre-determined level of primary surplus (amounting to 6.5% for the first 5 periods, and then gradually decreasing it to reach to 1.6% in the long-run).

Throughout the simulation analysis no further policy shock is assumed. Furthermore, no trade shocks are envisaged and the world terms of trade is regarded unchanged.

The macro and fiscal results of the scenario are given in the upper panel of Table 3.2. With an average interest rate of 10.1%, and an average output growth rate of 4.5%, the model predicts a gradual decrease in the ratio of total debt stock to output, reaching to 76.4% during the 5th period (year 2012-2013) and 72.2% during the 10th period (2022-2023).

Thus, at the outset, the program succeeds in constraining the explosive dynamics of debt accumulation; nevertheless, an inertial response in the path of the debt to GNP ratio over the medium run is observed. The simulation exercise highlights a set of points of vulnerability regarding the debt dynamics of the Turkish public sector. First level of the real rate of interest continues to exert significant burden on the government's

ability to administer its debt obligations. It must be observed that in the absence of any modeling of uncertainty and risk, the model's (endogenous) solution of the interest rate is determined entirely by the real marginal product of capital. This rate, being driven exclusively by the supply of physical capital, signals that the cost of capital remains significantly high even in the absence of currency and/or financial risk. This result is ultimately the outcome of the historically low private saving propensity.

The model results suggest that private savings remain on the order of 20% of the GNP over the simulated path. Coupled with the fact that savings generation capacity of the public sector is actually in the negative range (see Table 3.2), the realized gap in the aggregate savings funds necessitate increased dependence on foreign savings, i.e., the external deficit tends to widen over the PSP scenario. The model results disclose an increase in the ratio of foreign savings (external deficit) to GNP to 15.6% by the 10th period (2022-2023) from its base value of 8.1% in 2002/2003.[38] Under these conditions fixed investments can hardly be maintained and the rate of growth of physical capital stock proceeds at a significantly low pace. This fact seems to play a pivotal role in the sluggish behavior of the production capacity. On the fiscal side government's total tax revenue as a ratio to the GNP displays a slightly decreasing pattern, reaching to 15.6% during the 10th period, starting from a value of 16.6%[39]. As government expenditures (net of interest payments) is the only variable that adjusts to reach the pre-determined level of primary surplus targets, we observe a parallel movement of this variable with the government tax revenues, as well.

[38]The only agent incurring debt in the model is the government. Therefore, any additions to the foreign borrowing requirement of the economy is treated as an accumulation to the public debt stock.

[39]The reason why we do not observe a constant ratio despite proportional taxes is that during transition, the growth rate of labor input, labor income, capital stock and output are different.

	6.5% Primary Surplus, Standard Scenario							
Period:	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
(As a ratio to GDP)								
Private Consumption	0.6322	0.6354	0.6377	0.6391	0.6408	0.6419	0.6410	0.6397
Private Savings	0.2448	0.2332	0.2223	0.2122	0.2029	0.1777	0.1703	0.1634
Total Investment	0.3133	0.3113	0.3103	0.2951	0.2946	0.2969	0.2941	0.2966
Capital Stock	4.0526	4.1271	4.1997	4.2707	4.3344	4.5196	4.5804	4.6391
Fiscal Balances								
Total Debt Stock	0.8238	0.8079	0.7901	0.7705	0.7644	0.7395	0.7288	0.7218
Primay Balance	0.0650	0.0650	0.0650	0.0650	0.0650	0.0505	0.0505	0.0450
Government Expenditures (Net of Interest Payments)	0.1013	0.1001	0.0988	0.1126	0.1115	0.1080	0.1117	0.1105
Government Taxes	0.1663	0.1651	0.1638	0.1626	0.1615	0.1580	0.1567	0.1555
Interest rate*	0.1071	0.1052	0.1034	0.1017	0.1002	0.0961	0.0948	0.0936
Average Wage Income Index (2002-2003=100)	104.953	110.043	115.308	120.733	126.168	143.642	149.905	156.347

	6.5% Primary Surplus, Lower Growth Rate							
Period:	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
(As a ratio to GDP)								
Private Consumption	0.6715	0.6874	0.7035	0.7194	0.7363	0.7837	0.7983	0.8131
Private Savings	0.2057	0.1817	0.1575	0.1334	0.1094	0.0393	0.0166	-0.0060
Total Investment	0.2740	0.2592	0.2443	0.2146	0.1988	0.1546	0.1312	0.1175
Capital Stock	4.1028	4.2282	4.3585	4.4905	4.6180	4.9784	5.0929	5.2010
Fiscal Balances								
Total Debt Stock	0.8387	0.8396	0.8421	0.8455	0.8658	0.9369	0.9645	1.0054
Primay Balance	0.0650	0.0650	0.0650	0.0650	0.0650	0.0505	0.0505	0.0450
Government Expenditures	0.1013	0.1002	0.0990	0.1128	0.1117	0.1085	0.1173	0.1161
Government Taxes	0.1663	0.1652	0.1640	0.1628	0.1617	0.1585	0.1573	0.1561
Interest rate	0.1058	0.1027	0.0996	0.0967	0.0940	0.0872	0.0852	0.0835
Average Wage Income	103.088	105.895	108.257	110.237	111.682	114.538	115.018	115.181

	6.5% Primary Surplus, Higher Growth Rate							
Period:	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
(As a ratio to GDP)								
Private Consumption	0.6135	0.6100	0.6047	0.5978	0.5906	0.5655	0.5562	0.5473
Private Savings	0.2634	0.2583	0.2549	0.2529	0.2522	0.2528	0.2536	0.2547
Total Investment	0.3320	0.3367	0.3433	0.3365	0.3448	0.3736	0.3741	0.3841
Capital Stock	4.0437	4.0952	4.1389	4.1758	4.2004	4.2725	4.2992	4.3242
Fiscal Balances								
Total Debt Stock	0.8197	0.7960	0.7687	0.7376	0.7181	0.6468	0.6191	0.5996
Primay Balance	0.0650	0.0650	0.0650	0.0650	0.0650	0.0505	0.0505	0.0450
Government Expenditures	0.1013	0.1000	0.0988	0.1125	0.1113	0.1078	0.1165	0.1154
Government Taxes	0.1663	0.165	0.1638	0.1625	0.1613	0.1578	0.1565	0.1554
Interest rate	0.1074	0.1060	0.1049	0.1040	0.1034	0.1016	0.1010	0.1004
Average Wage Income	105.488	111.661	118.455	125.941	134.065	163.060	174.468	186.693

** Marginal product of physical capital*

Table 3.2: Macroeconomic Balances

3.4.4 Checking for the Vulnerability of the PSP Path

The laboratory characteristics of the OLG set-up is now utilized to check for the sensitivity of the PSP to exogenous shocks on growth. I first introduce a "low growth" scenario, where the growth rate of the total output is allowed to fall below the rate of growth of the benchmark path recognized for the official PSP. Formally, the rate of technological improvement is exogenously reduced for the first 5 periods, then allowed to gradually reach the equilibrium level in the long-run (after period 30). Versions of this scenario have become a part of the routine sensitivity analysis of what is referred as partial equilibrium "accounting exercises" conducted by many finance institutions as well as the official government bodies. Arguably, given the broader, general equilibrium context of the model here, the results reported provide an interesting contrast to such partial equilibrium exercises. I find that such an adverse shock on the rate of technological improvement causes the average growth rate of total output to be reduced to 1.3% for the first 10 periods. Yet, the primary surplus target is kept unchanged. The middle panel of Table 3.2 emphasizes selected variables as a ratio to GNP, while Table 3.3 pictures deviations from the benchmark path (the official program). The rates of growth envisaged under the alternative scenarios are further contrasted in Figure 3.4

Given that the interest rate (marginal product of physical capital) attains a value of 9.4% on average for the first 10 periods, adherence to the program target of 6.5% of primary surplus leads to a reversal of the path of the total debt/output indicator. This ratio increases significantly reaching to a value of 100.5% over 2022-2023. This amounts to a 2.6% higher level of aggregate debt stock in comparison to the benchmark economy, and to 26.3% lower level of GNP by that period. Figure 3.5 portrays the contrasting paths of the debt/GNP ratio under the simulated growth shocks.

	6.5% Primary Surplus, Lower Growth Rate							
Period:	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
GDP	0.9823	0.9623	0.9389	0.9131	0.8852	0.7974	0.7673	0.7367
Private Consumption	1.0433	1.0410	1.0357	1.0278	1.0171	0.9736	0.9556	0.9364
Private Savings	0.8254	0.7497	0.6652	0.5740	0.4773	0.1764	0.0748	-0.0271
Private Investment	0.8591	0.8012	0.7392	0.6640	0.5973	0.4152	0.3423	0.2919
Total Assets	0.9949	0.9870	0.9765	0.9633	0.9474	0.8856	0.8609	0.8344
Capital Stock	0.9944	0.9858	0.9744	0.9601	0.9020	0.8784	0.8532	0.8259
Effective Labor	0.9705	0.9397	0.9053	0.8692	0.8319	0.7253	0.6916	0.6586
Total Profit Income	0.9828	0.9635	0.9406	0.9159	0.8888	0.8036	0.7737	0.7443
Total Wage Income	0.9822	0.9623	0.9388	0.9131	0.8852	0.7974	0.7673	0.7367
Foreign Savings *	0.9850	0.9681	0.9485	0.9271	0.9043	0.8361	0.8139	0.7922
Fiscal Balances								
Total Debt Stock	1.0000	1.0001	1.0006	1.0019	1.0026	1.0103	1.0156	1.0261
Total Expenditures (Net of Interest Payments)	0.9826	0.9630	0.9402	0.9148	0.8875	0.8011	0.8053	0.7740

	6.5% Primary Surplus, Higher Growth Rate							
Period:	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
GDP	1.0051	1.0147	1.0273	1.0432	1.0626	1.1351	1.1639	1.1942
Private Consumption	0.9753	0.9741	0.9742	0.9758	0.9793	1.0000	1.0099	1.0217
Private Savings	1.0814	1.1239	1.1780	1.2433	1.3207	1.6149	1.7332	1.8615
Private Investment	1.0651	1.0975	1.1366	1.1896	1.2436	1.4284	1.4805	1.5465
Total Assets	1.0026	1.0063	1.0115	1.0186	1.0277	1.0694	1.0884	1.1101
Capital Stock	1.0029	1.0068	1.0125	1.0200	1.0562	1.0731	1.0925	1.1131
Effective Labor	1.0072	1.0224	1.0421	1.0665	1.0958	1.1994	1.2385	1.2794
Total Profit Income	1.0054	1.0140	1.0262	1.0416	1.0605	1.1306	1.1596	1.1908
Total Wage Income	1.0051	1.0147	1.0273	1.0431	1.0626	1.1352	1.1639	1.1941
Foreign Savings *	1.0037	1.0114	1.0217	1.0346	1.0502	1.1054	1.1259	1.1473
Fiscal Balances								
Total Debt Stock	1.0000	0.9998	0.9995	0.9987	0.9982	0.9928	0.9888	0.9920
Total Expenditures (Net of Interest Payments)	1.0049	1.0143	1.0267	1.0424	1.0614	1.1330	1.2137	1.2465

* Adjusted Current Account Deficit which equals: Merchandise trade deficit + Interest payments abroad, not including other factor incomes

Table 3.3: General Equilibrium Results - Ratio of Deviation from the Primary Surplus Program

The adverse shock on the productivity growth rate of the labor-augmenting technology directly causes a decrease in the aggregate effective labor. Similarly, the total capital stock shows significant deviation from the base-run, although capital stock-output ratio gradually rises. (See Figure 3.6). This is due to the fact that foreign savings increase (current account deficit widens even further) at a higher rate in

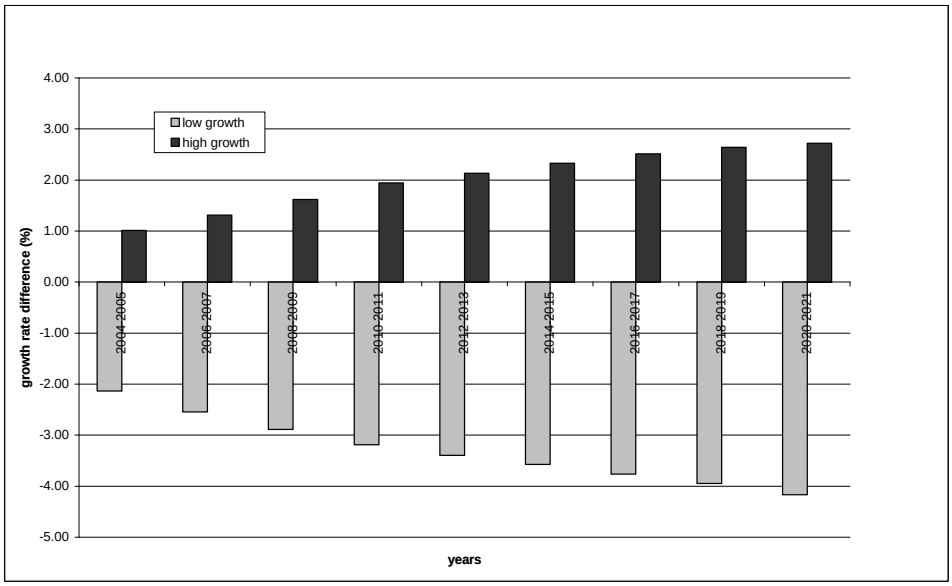

Figure 3.4: Growth Rate Differences With Respect To Primary Surplus Program

comparison to the rate of growth of GNP during the period of transition. Furthermore, with relatively lower level of interest rate and lower average wage earnings, disposable income of the private sector shows considerable reduction. From Table 3.3 total profit and wage income show a negative deviation on the order of 30% with respect to the PSP scenario. Given the calibrated rate of time preference for the private households, the optimal consumption behavior of the private agents causes the aggregate consumption-output ratio to increase over time. The reduction of private disposable income together with increasing consumption-output ratio causes the paths for savings/output and investment/output to decrease significantly over time. This outcome, no doubt, leads to decelerated production activity.

From the point of view of "fiscal balances and debt sustainability", one of the most relevant questions to ask is what would the level of primary surplus be in order to sustain the total debt stock under the adverse condition of low growth. That is, given

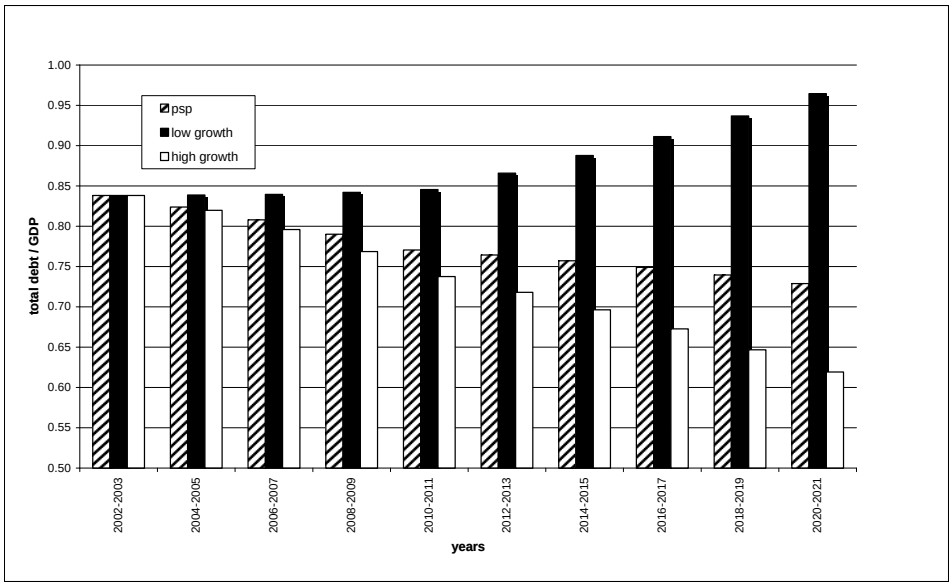

Figure 3.5: Total Debt to GNP Ratio

the warranted (sustainable) path for the debt to GNP ratio as generated under the official PSP scenario, by how much should the primary surplus be increased? To answer this question I run a "constrained" simulation of the model and calculate numerically the necessary ratio of the primary surplus to GNP that will hold the debt dynamics in the same path as in the official benchmark equilibrium. The simulated result is illustrated in Figure 3.7. The model results suggest that in order to keep the debt to GNP ratio at its officially planned path, the public sector primary surplus would need to be increased to 8.2% of the GNP for four consecutive periods (until 2010), and then would have to remain by approximately 2 percentage points over the rest of the planning horizon. Thus, our sensitivity analysis suggests that a decline of the growth rate by 3.2 percentage points on average would require an increase in the primary surplus to GNP ratio by roughly 1.7 percentage points. It remains an open question whether the Turkish economy would be able to absorb such a contraction of public expenditures over such an extended period, and whether it is politically/socially realistic to expect the private households to endure the consequent deterioration of public services for

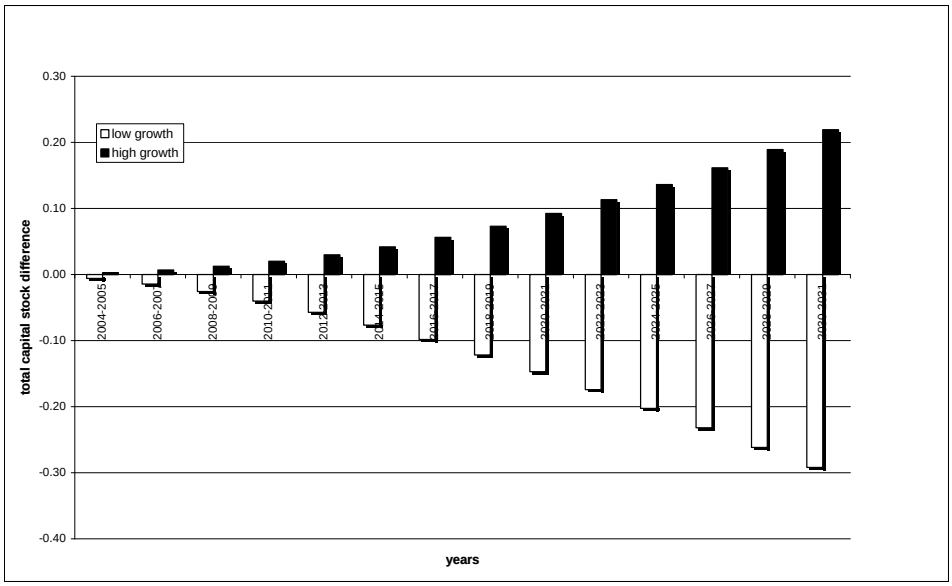

Figure 3.6: Total Capital Stock - Deviation from the Primary Surplus Program

that long.

In checking for the vulnerability of the path of the economy under "PSP", one relevant question would be about a constraint of the government on creating external deficit. Note that under "PSP" the model discloses an increase in the ratio of foreign savings to GNP from a value of 8.1% in the base year to 15.6% by the 10^{th} period. The demand for foreign borrwing gets even higher under an adverse growth shock (see Table 3.3). Given the dependence on high levels of foreign borrowing (which results from the export supply and import demand behavior of both the private and the public sector of the economy) analyzing the effects of an external borrowing constraint becomes a significant issue. Table 3.4 illustrates the behavior of the selected variables in case that from a value of 8.1% of GNP in the base year, the economy's foreign borrowing possibility is gradually constrained.

As foreign borrowing possibilities are constrained, each period financing of the newly issued debt relies potentially on domestic economy. Because higher ratio of the

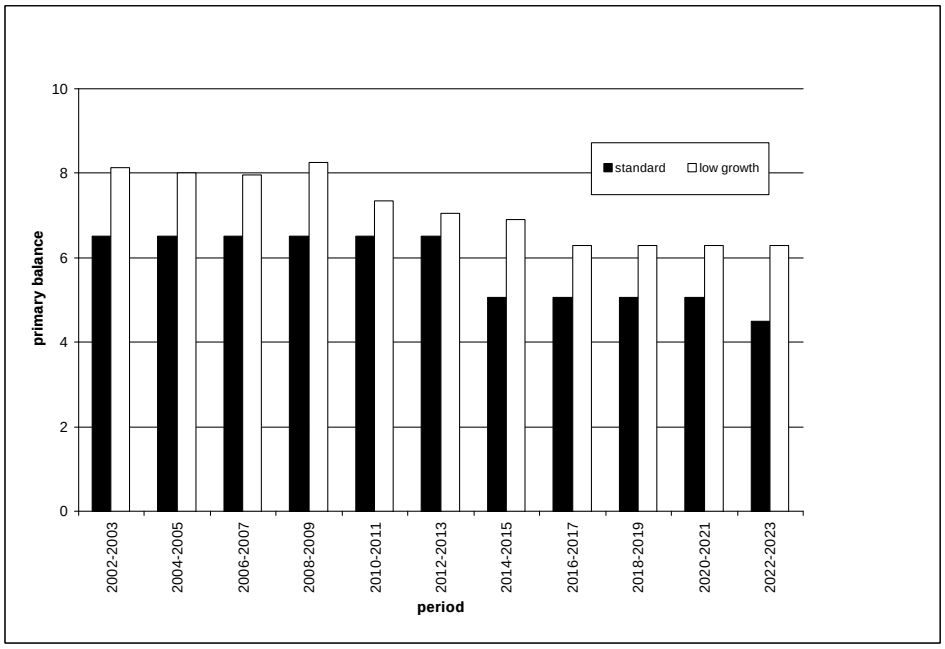

Figure 3.7: Necessary Primary Balance/GNP Ratio for Debt Sustainability under the Low Growth Scenario

domestic asset accumulation is now allocated to finance the public sector borrowing requirement, the capital stock to be used in production is reduced. The rental rate of capital, interest rate increases. Although such an increase leads to higher level of asset accumulation in the economy in comparison to the Primary Surplus Program, the level of investment continuously decreases. For the first 10 periods, growth rate of output drops down to 3.91% on average from a value of 4.45% under "PSP". Intense dependence on domestic borrowing, maintanence of the primary surplus targets and the contraction of the production activity in the economy leads to the deterioration of the dynamics of total debt stock. Total debt, as a ratio to GNP increases to 77.50% in the 5^{th} period and to 76.76% in the 10^{th} period, sticking to an increasing path thereafter. Summarizing, the model results indicate significant degrees of deviation in the paths of the growth rate of the economy and the total debt stock in case of constrained possibilities for external borrowing.

Constrained Foreign Borrowing								
Period:	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
GDP	1.0003	0.9992	0.9967	0.9931	0.9883	0.9728	0.9672	0.9614
Private Consumption	0.9848	0.9822	0.9795	0.9772	0.9750	0.9707	0.9695	0.9686
Private Savings	1.0420	1.0553	1.0716	1.0885	1.1071	1.1682	1.1904	1.2132
Private Investment	0.9636	0.9186	0.8727	0.8181	0.8007	0.7454	0.7219	0.7014
Total Assets	1.0015	1.0034	1.0057	1.0085	1.0118	1.0242	1.0292	1.0347
Capital Stock	1.0006	0.9982	0.9933	0.9860	0.9764	0.9458	0.9348	0.9235
Effective Labor	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total Profit Income	1.0012	1.0044	1.0090	1.0159	1.0240	1.0535	1.0649	1.0772
Total Wage Income	1.0003	0.9992	0.9967	0.9931	0.9883	0.9728	0.9672	0.9614
Foreign Savings *	0.7632	0.6111	0.4764	0.3571	0.3344	0.2776	0.2617	0.2470
Fiscal Balances								
Total Debt Stock	1.0000	0.9999	1.0001	1.0007	1.0019	1.0110	1.0162	1.0223
Total Expenditures (Net of Interest Payments)	1.0010	1.0026	1.0050	1.0061	1.0087	1.0177	1.0187	1.0218

* Adjusted Current Account Deficit which equals: Merchandise trade deficit + Interest payments abroad, not including other factor incomes

Table 3.4: Constrained Foreign Borrowing-Ratio of Deviation from the Primary Surplus Program

3.4.5 A High Growth Scenario

Of course not all shocks ought to be on the *negative* side. Given a sufficiently optimistic attitude, one can also fiction an exogenous positive shock to the rate of technological change. Under a new scenario, we briefly report on the behavior of the model in response to a positive technological shock on effective labor. We report our results on the last panel of Tables 3.2 and 3.3, and portray in Figures 3.4 through 3.6.

The growth rate of total output reaches to 6.5% on average for the first 10 periods. The primary surplus targets are still kept as before. As would be expected, the higher growth rate brings all positive effects to the economy. Since both the effective labor and total capital stock increase relative to the base-run, output is now higher, providing higher profit and wage incomes to the private households. (See Table 3.3). Savings and investment increase both in level terms and as a ratio to the GNP.

Total debt stock-output ratio decreases considerably, reaching to 59.9% under the constraints of the modeling framework used in this study. Moreover, the total debt stock as a level variable is now lower then its value in the benchmark economy. This

result is achieved without the government being obliged to decrease in its expenditures in level terms. The government expenditures net of interest payments increase by some 6.1% during period 5, and by 24.6% during period 10 compared with the baseline scenario.

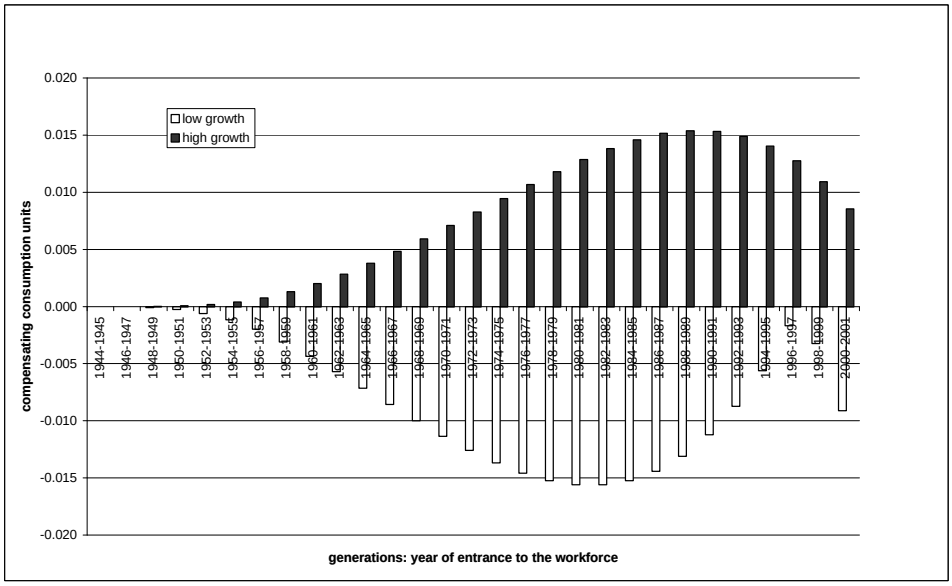

Figure 3.8: Welfare Analysis for Generations Entering the Workforce before Base Year

I finally report on the social welfare consequences of the scenarios considered. As a measure of this variable, the utility in "compensating consumption units" based on the methodology used by King and Rebelo (1990) is used. Denote $U_t(\{c_g\}_{g=1}^{30})$ as the lifetime utility of an agent entering the workforce at time t, by following a consumption path $\{c_g\}_{g=1}^{30}$ under the benchmark economy. The welfare gain (or loss) associated by the shock θ is such that $U_t(\{c_g(1-\theta)\}_{g=1}^{30}) = U_t(\{c'_g\}_{g=1}^{30}).\{c'_g\}_{g=1}^{30}$ is the path of consumption of the agent after the shock. Figure 3.8 shows the welfare loss (or gain) of past generations (generations entering the workforce before base year, 2002-2003) and Figure 3.9 shows the deviation in the welfare of future generations under low and high growth scenarios. As followed from the figures, a high growth scenario would increase

the welfare of both the present and future generations. The welfare increase in future generations would be much comparable since these generations are the ones that will totally benefit from the "higher growth rate". On the other hand, the "adverse growth shock" would also put much burden on the future generations to enter the workforce.

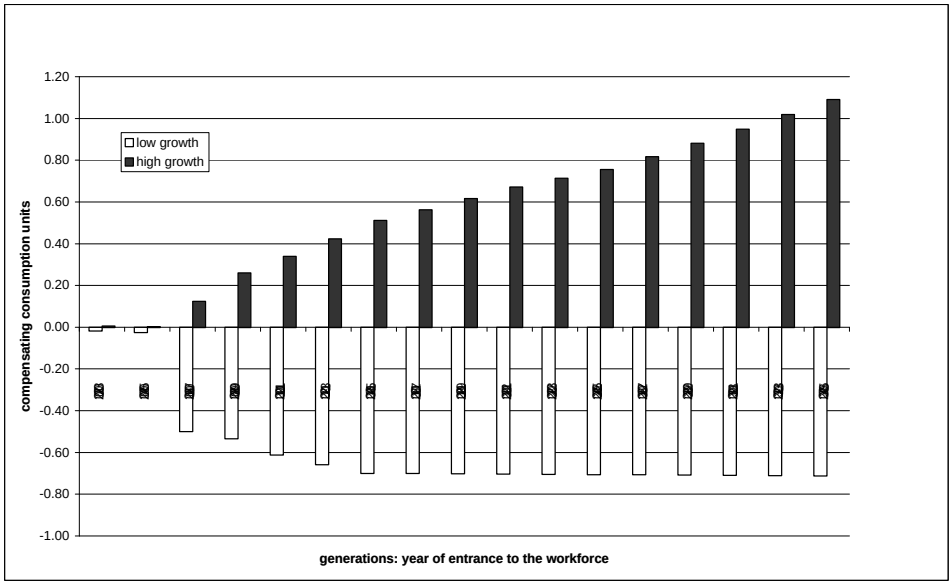

Figure 3.9: Welfare Analysis for Generations Entering the Workforce after Base Year

3.4.6 Concluding Comments

In this chapter, the welfare and growth implications of the Turkish fiscal austerity program as directed and supervised by the IMF are studied. The program, advanced in May 2001 and referred as the "Turkey's Program for Transition to a Strong Economy", included the standard IMF austerity measures: drastic cuts in public spending, monetary contraction, flexible exchange rate management, and reductions in wage remunerations and in public employment. In particular, the TSEP has targeted a primary fiscal surplus of 6.5% to the GNP every year until 2004, and aimed at reducing the outstanding net stock of domestic debt to 40.9%, and that of foreign debt to 40.3%

as a ratio of GNP by the end of that year.

The IMF-led austerity program which is extended now to be in operation at least until 2006 is criticized heavily in that it gives priority to targets on fiscal debt rather than growth, and implements an implicit preference for finance over industry. Furthermore, the program is accused of lacking credible public support and of general ignorance on its social welfare implications. The program targets are studied mostly under a partial equilibrium setting in terms of accounting exercises around three variables: growth rate of GNP, the (real) rate of interest, and the non-interest (primary) fiscal surplus as a ratio to the GNP. This simplistic accounting approach is criticized for its lack of a general equilibrium framework.

Thus, given the dubious macro-policy environment the attempt here is to investigate the growth and welfare consequences of the current austerity program as well as its sensitivity (vulnerability) to various technological shocks in an inter-temporal, general equilibrium setting. To this end, I used of an exogenous growth, overlapping generations (OLG) model, calibrated to the Turkish data over 1990s.

Using the OLG set-up, first the implications of the austerity program focusing exclusively on fiscal balances are studied . In doing this, fiscal targets of the TSEP to attain a primary surplus of 6.5% as a ratio to GNP until 2006 to be complemented by equilibrium in the primary balance of the public sector then after are maintained.

As simulated over the time horizon as above, the model results suggest that the current fiscal program based on the primary surplus objective succeeds in containing the explosive dynamics of debt accumulation, and yet, the path of aggregate public debt as a ratio to GNP displays significant degree of inertia and would be brought down only gradually and slowly. With an average interest rate of 10.1%, and an average output growth rate of 4.5%, the model predicts a gradual decrease in the ratio of total debt

stock to output, reaching to 76.4% during 2012/2013, and to 72.2% during 2022/2023.

Next, the sensitivity of the official program path to exogenous shocks on growth (technological change) is checked. To this end, I introduced a "low growth" scenario where the growth rate of total output is let to fall below the rate of growth of the benchmark path recognized for the official program. The most significant finding is that, under possible adverse shocks on the rate of technological improvement, adherence to the given program targets on fiscal austerity immediately leads to a reversal of the path of the total debt/output indicator. This ratio increases significantly reaching to a value of 100.5% over 2022-2023. Roughly, in order to compensate for a 3.2 percentage points of decline in the rate of growth below its officially targeted rate of 4.5% over the 2001-2006 horizon, the primary surplus of the public sector should be increased by 1.7 percentage points as a ratio to the GNP, from the targeted ratio of 6.5%, to 8.2%, over an extended period of ten consecutive years.

Chapter 4

Overlapping Generations Modeling of the Turkish Austerity Program - Endogenous Growth Approach

4.1 Introduction

In Chapter 3, I utilize a model of "exogenous" growth, and I rely on exogenous shocks of growth and analyze the macro-consequences in a model calibrated to Turkish economy. In this chapter, my focus will be on the impact of government policies on capital formation, welfare and growth. Section 3.4 of Chapter 3 highlights that the influences of government debt on the macro-economy under finite-lifetimes offer a more realistic set-up in comparison to the infinite-lived agent framework. Likewise, in this chapter, it will be more appropriate to work within a framework of finite-lifetimes. Therefore, in this chapter, I develop a model of endogenous growth in the OLG tradition to study the effects of fiscal and social policies of the government under the constraints of debt servicing and a binding fiscal gap. The growth process is characterized by the accumulation of both physical and human capital. Public spending on accumulative factors of production, as well as the society's endowment of social capital contribute to the function of productive factors.

Section 4.2 introduces the antecedents of the human capital driven endogenous growth. It emphasizes the involvement of public sector in the process of accumulation through the public content of education. Section 4.2.3 presents the relevant large-scale OLG models that discuss fiscal policies.

In Section 4.3, I present a simple model of endogenous growth to study the effects of the choice of taxation policy on the growth rate of the economy. The model is an OLG model where the agents live for two-periods and the labor-augmenting technology depends on the accumulation of human capital through public investments on education. The model is simple, but useful in presenting the relationship between government productive expenditures, choice of taxation and the accumulation patterns and growth.

In choosing out the simulations, I emphasize the trade-off between the paths of two basic variables, the growth rate of the economy and the total debt stock. With respect to the discussion in Section 3.2, an ever-rising debt stock is considered as an indicator of "unsustainable" fiscal policy. The question that whether it is possible to avoid "unsustainable" characteristics of the fiscal balances and to achieve a comparable growth rate for the economy has been the main guide of simulation exercises in this chapter.

In the remaining parts of the chapter I develop a large-scale endogenous growth model calibrated to Turkish economy in 1990s. The model examines the macroeconomic effects of the current austerity program driven by the objective of attaining primary fiscal surpluses and illustrate the ruinous effects of the constrained human capital investments due to insufficient funds to public education. I then examine taxation alternatives to mitigate the reductions in the availability of public funds to reproducible factors of production. Given the experience of 1990s and given the blurred picture

ahead of the Turkish economy, this study is timely in analyzing the welfare and growth implications of the Turkey's recent process of transformation of its macro and fiscal structure and investigate the trade-offs over intergenerational distribution of wealth, accumulation and growth.

In the first simulation exercise of Section 3.4.2, I study the specifics and the expected macro-economic consequences of the current austerity program, as implemented. The distinguishing characteristic of the simulation is the attainment of primary surplus targets as set out in the official documents. Then, as an alternative policy environment I simulate a fiscal expenditure-cum-tax reform strategy. Here, rather than focusing on stabilization of debt dynamics through primary fiscal surpluses, the objective is to implement selective tax reforms and to support an increased public expenditure program on education. The resulting trade-offs between the attainment of fiscal targets and growth of the economy suggested the simulation of what I call a "Hybrid Program". This is designed to search for the answer to the question of the possibility of existence of a program keeping the advantageous rate of growth and constraining the explosive debt dynamics.

The main message from the simulations is that alternatives of fiscal programming do exist and it requires an energetic and decisive state apparatus to carefully weigh the merits of each of the alternatives against the dubious prospects of the current program in implementation. In reaching such a message the model in this chapter points to the importance of government productive expenditures in the dynamic macro-path of the economy, using the education expenditures as a natural candidate to represent the productive property of the public sector.

4.2 Antecedents of Human Capital Driven Endogenous Growth

4.2.1 New Growth Evidence on Human Capital and Public Provision of Education

Since mid-1980s advances in "new growth theory", motivated by the observation that the determinants of long-term economic growth are crucial, have led to construction of growth models in which the key determinants of growth are *endogenous*.[1] This literature captures the insight that the crucial force behind positive rates of growth is the elimination of the tendency of diminishing returns to investment and takes a broader view of capital, either by producing human capital as an additional factor of production (Uzawa (1965), Lucas (1988)) or by attributing growth to existing stock of capital which generates innovations (Romer (1990), (1994)), or spillovers (Nelson and Phelps (1966), Grosman and Helpman (1991)).

The substantial development of endogenous growth models introducing more plausible mechanisms for technological change compared with the standard neo-classical theory has led to an outpouring of empirical work using more sophisticated techniques of "growth accounting" and "cross-country regressions". Such work, taking into account the new roles of both physical and human capital, has significantly reduced the "residual" component of the Solow growth model.

Different growth models which came out as a result of the interaction of the "new growth theory" with the "new empirics of economic growth" identify and emphasize the role of human capital and its rate of accumulation as one of the basic *proximate* sources of economic growth.[2] The results of the earlier works on the "significance" of human

[1] Antecedents of this literature are Arrow (1962), Sheshinski (1967) and Uzawa (1965) which did not include a theory of technical change. Built on those studies, Romer (1986), Lucas (1988) and Rebelo (1991) constitute the initial wave of research followed by many others. See Barro and Sala-i Martin (1985) and Aghion and Howitt (1998) for recent surveys.

[2] See Durlauf and Quah (1998) for an excellent overview of recent growth models based on the new

capital in explaining economic growth is rather mixed, especially when the "changes in human capital" variable is taken into consideration. The coefficient of the variable representing changes in human capital over the period of growth in growth regressions of Benhabib and Spiegel (1994), Pritchett (1997) and Bils and Klenow (2000) have been surprisingly weak. Yet, more recent work argue that the important reason for earlier findings ties in the quality of the data and mis-interpretation of the variables to represent the "human capital". Importantly, empirical work, based on new measures of human capital provides stronger support for the hypothesis that human capital and its accumulation through education play an important role in the decomposition of growth rate differences. Topel (1999), De La Fuente and Domenech (2000), Temple (2001b) and Krueger and Lindahl (2001) point to the significance of both the initial level of human capital and the change in its amount as important determinants of economic growth. Consequently, issues such as the accumulation of human capital through the education system, the pivotal role played by both the private and public funds, and government's educational policy have meant topics of crucial importance for many researchers of theory and empirics of growth.[3]

Educational spending for accumulation of human capital as an engine of growth is also of interest because it has an enormous public component which makes it a typical example of the so-called "publicly provided private goods". Traditionally, the amount of schooling provided is heavily dependent on the public sector. In the U.S., the average education expenditures is just under 7% of GDP, 55% of which is provided by government, enrolling 89% of school children. Public and private expenditure on educational institutions accounts for over 6% of the collective GDP of the OECD member countries, or roughly $1550 billion each year (OECD (2000)). As in the U.S.,

empirics of economic growth.

[3]A rigorous survey can be found in Aghion and Howitt (1998). See also Bils and Klenow (2000), Romer (2000) and Temple (2001b) and (2001a).

the data on OECD suggest not only relatively larger contribution of public spending on education and training, it also suggests that the government is typically the provider of the majority of formal education and training services.[4]

Under these conditions, provision to public funds to education and the government's ability to revenue generation to invest in education, and human capital formation which come out of the collective decision of fiscal policies play a crucial role in promoting growth.[5] This observation bring issues like human capital formation, optimal design of public policies in terms of investments in education, fiscal debt management, and inter-generational burden of taxation to forefront of analysis in the study of macroeconomic policy and economic growth.

Regardless of the relationship of government spending and human capital accumulation, the results of studies on the effect of fiscal policy on economic growth are rather mixed. A priori, macroeconomic policies smoothing fluctuations, implying fiscal prudence and achieving low inflation would likely to help economic growth. Barro (1991), Fischer (1993) and Easterly and Rebelo (1993) argue that high deficit periods are usually associated with low growth rates, and fiscal surplus is generally regarded as a signal for stability. However, the general conclusion is that the effects of fiscal policy on growth depend significantly on how revenue is raised and what expenditures it is devoted to.[6]

[4]According to Ministry of Education, in 2001-2002 in Turkey, 96% of all the schools are public schools. 98% of the school children are educated in public schools which employ 95% of the teachers.

[5]Perhaps the best known paper on the subject of public education is Stiglitz (1974). Among other noteworthy references are Glomm and Ravikumar (1992), Saint-Paul and Verdier (1993), Fernandez and Rogerson (1995).

[6]Miller and Russek (1997) find that, in general debt financed expenditures do not appear to effect growth, whereas the portion allocated to education has a significant (+) sign. Mendoza, Milesi-Ferretti and Asea (1997) report that, the effect of revenue increases of the public sector on growth depends on the way they are financed. In their study, a capital income taxation has a positive effect on the growth rate, but a labor income taxation tends to have a negative effect. See Ahn and Hemmings (2000) for a summary of fiscal influences on growth.

4.2.2 Human Capital Production as an Engine for Growth

This section reviews the literature on human capital production functions. The human capital function which I use in this chapter of the dissertation is derived directly from the literature.

In Lucas (1988), the level of output is a function of the stock of human capital which is generated by a recursive function on itself. Formally, the production function in per-capita terms:

$$y_t = Ak^{\beta}(uh)^{1-\beta}h_a^{\gamma}$$

where k is the per-capita capital stock, u is the fraction of time the representative agent devotes to production, h is her human capital and h_a is the average level of human capital. The existence of "average level of human capital" as a factor of production creates an externality since no individual agent in a competitive economy will consider this effect when determining how long to allocate to education. The human capital function is given as a differential equation,

$$\dot{h_t} = h_t\theta(1 - u_t)$$

where $(1-u_t)$ is the fraction of time an individual spends studying, and θ is a parameter.

Jones and Manuelli (1992) explain the role that the human capital production function plays as an "engine of growth" for an economy by considering a problem faced by overlapping generations models, where the goods production function has constant returns to scale. Specifically, unlike the infinite-lived agent models, in a setup where agents live for finite periods, the higher interest rate does not guarantee that aggregate consumption level increases over time. In the overlapping generations model, in order to achieve sustained growth, the income of the young agent must be sufficient to buy both consumption and next period's stock of physical capital. That is, if e_t represents

"efficiency" labor of the representative young agent and w_t is the wage rate per efficiency units of labor, $w_t e_t = c_t + k_{t+1}$ where c_t is consumption and k_{t+1} is the next period's capital stock. To ensure a sequence of capital stock, $\{k_t\}$ growing and not converging, the condition $\frac{w_t e_t}{k_t} > \frac{k_{t+1}}{k_t}$ has to be satisfied. To avoid the first term to converge asymptotically to zero as $k \to \infty$, e has to be an increasing as fast as k.[7]

Lucas (1988) is an infinite-lived agent model. In this model, Lucas suggests that his equation for the accumulation of human capital can be extended to an overlapping generations model by allowing h_t to stand for the level of family human capital to allow each generation inheriting a given amount of human capital.

Glomm and Ravikumar (1992) highlight the distinction between economies with public education and those with private education. In examining the implications of public investment in human capital on economic growth and the evolution of income inequality, they assume a human capital accumulation function of the form:

$$h_t = \theta(1 - u_{t-1})^{\beta} q_{t-1}^{\gamma} h_{t-1}^{\delta} \qquad \theta > 0 \quad \beta, \gamma, \delta \in (0, 1)$$

where h_t is the stock of human capital of an agent at time t who has allocated $(1 - u_{t-1})$ units of her one unit of divisible time to human capital accumulation. q_{t-1} is the variable representing the quality of education. h_{t-1} is the human capital of the corresponding parent. In a later study, Glomm and Ravikumar (1997) compare the effects of public investment in infrastructure and education, and use the following human capital production function:

$$h_t = \beta h_{t-1}^{\mu} g e_{t-1}^{1-\mu}$$

where ge_{t-1} denotes the amount of per-capita public expenditures devoted to education in period $t - 1$.

[7]The proof is an application of Euler's Theorem. See Jones and Manuelli (1992).

Caballé (1995) investigates the relationship between growth and intergenerational bequests in an overlapping generations economy with altruistic individuals, and assumes human capital of an agent accumulates through:

$$h_t = \chi(pe_{t-1}, \bar{pe}_{t-1})$$

where pe_{t-1} is the parental investment in human capital, $\bar{pe}_{t-1}$ is the average level of per-capita education investment in period $t-1$. χ is assumed to be linearly homogeneous function with $\chi_1, \chi_2 > 0$.

Buiter and Kletzer (1995) analyze the effect of fiscal policies on economic growth under both an open and a closed economy framework under the assumption that the human capital formation of the young is constrained by the illiquidity of physical wealth. The production function of human capital they use is:

$$h_t^1 = \delta h_t^0 \left[1 + \epsilon\left(\frac{pe_t + ge_t}{\gamma h_t}\right)\right]$$

h_t^1 is the stock of human capital at time $t+1$ of a middle-aged agent, who was born at time t with h_t^0 endowment of human capital. In their study, $h_t^0 = h_{t-1}^1$, is the average human capital achieved by the previous generation during middle age, pe_t is the private educational purchases by the agent born at time t when young, and ge_t denotes public education spending on the same household at date t. The function ϵ is non-negative, increasing, strictly concave and twice continuously differentiable with $\epsilon(0) = 0$. Parameter $\delta \in [0, 1]$ allows for the depreciation of human capital.

4.2.3 Fiscal Policy and Growth in Large-Scale OLG Modeling

As highlighted in Section 3.4.1, Chapter 3, the OLG framework was traditionally based on the process of accumulation of wealth on "life-cycle theory". Agents save and dissave at different stages of their lives to smooth consumption. The characteristics

of an OLG model, that is, its dynamic structure and its allowance for differentiation of individuals not only by their ages, but also by their wealth-holdings, make it possible to study a large set of economic issues. Aggregate implications of life-cycle savings by individuals, the effects of redistributive government policies on capital formation, welfare of different generations and economic growth, effects of demographic shifts, effects of both intentional and unintentional bequest motives are among these issues.[8]

With reference to the result that a high interest rate is not sufficient to induce growth, Jones and Manuelli (1992) emphasize the role of government as an income re-distributor under the OLG setup which allows for persistent *endogenous* growth. One of the early applications of public debt management in finite horizons is that of Blanchard (1985). Persson (1985) analyzes the intergenerational welfare effects of a temporary deficit-financed tax cut in two-period overlapping generation models with various degree of trade openness. Likewise, Kotlikoff and Summers (1981), Liu (1994), and Renstrom (1996) are studies investigating the role of government policies in the context of finite lifetimes, among many others.

Among studies that incorporate endogenous growth with human capital under finite lifetimes and government policy analysis are Ni and Wang (1994) and Glomm and Ravikumar (1997) which let public spending on education directly enter the production function of human capital. In a model where human capital is produced by income-tax financed public expenditures on education, Ni and Wang try to answer the question to what extend should the government promote investment in human capital accumulation when the revenue to finance it comes from distortionary taxes. Glomm and Ravikumar, in turn, focus on the growth effects of productive government spending and growth-maximizing level of taxation. Bovenberg and van Ewijk (1997), in a continuous time

[8] Auerbach and Kotlikoff (1987) in Chapter 1 provide a list of questions related to dynamic fiscal policy that can be addressed in an OLG framework.

OLG model, follow the approach of Blanchard (1985) and explores the trade-off between efficiency and intra-generational equity in an economy with progressive taxation of wage income. Likewise, Buiter and Kletzer (1991), (1995) use OLG models with human capital accumulation to analytically study the effects of fiscal policies on economic growth.

Given the theoretical framework of endogenous growth with human capital accumulation under a finite-lived agent setup, a promising avenue of research would be building large-scale general equilibrium models where rational agents with finite-lifetimes and public sector with infinite horizon interact within a market-setting. In contrast to simple models, large-scale models with the assumption of a longer-time horizon provide a more realistic setup that will be able to address to the income distribution effects of policy changes. In this field, it is possible to consider simultaneous changes in a variety of fiscal instruments and provide ways to understand short-to-medium run responses by making it possible to observe the transition paths from one steady state to possible-other for the modeled economies.

The main reference to large-scale OLG models, incorporating fiscal policy analysis is that of Auerbach and Kotlikoff (1987). In this seminal work, growth is exogenous. Yet, by building up a model with 55 overlapping generations for the U.S. economy, the authors look at a large set of fiscal policy issues including deficit finance, changes in the level and timing of government spending, choice of tax base, social security and demographic changes. The last two issues in particular, have been the subjects of most quantitative studies in OLG framework including Auerbach, Hageman and Nicoletti (1989), Hviding and Mérette (1998), Fougère and Mérette (1999), and Kenç and Sayan (2001).

The generational complexity that large-scale OLG models possess necessitates

demanding simulation techniques. Therefore, studies that construct larger setup fiscal policy experiments in dynamic-models are usually a product of a research team. The DREAM (Danish Rational Economic Agents Model), models by Knudsen, Pedersen, Petersen, Stephensen and Trier (1997) and Jensen, Nielsen, Pedersen and Sorensen (1998) are studies built for the Danish economy. Both models, although constructed in different market structure settings, investigate macroeconomic and distributional effects of various fiscal policies.

In an endogenous growth model, where savings take place both in the form of physical and human capital, Mérette (1998) investigates the effects of alternative debt reduction policies, in a model calibrated to match 1995 Canadian data. His simulations show that growth can vary significantly during the transition from a high to a low-debt to GDP ratio.

More recently, Mérette (2000) takes a further step of including a financial sector into a large-scale model of finite horizons. In a dynamic general equilibrium model, he studies the effects of confiscation of financial assets as occurred in the Collor Plan in Brazil, 1990. Identifying the underlying mechanisms of the failure of this stabilization plan, Mérette suggests the need for fiscal reform to enlarge Brazil's fiscal base and enhance its tax administration.

Inspired by the literature summarized in this section, a more general aim of this dissertation is to contribute to this literature by investigating the growth and welfare effects of fiscal policies of financing public spending on education, within the context of an OLG model of Turkish economy.

4.3 A Simple Endogenous Growth Model to Study Fiscal Policies

The model in this section aims to discuss analytically the effect of government "productive" expenditures on the dynamics of the economy. The analytical structure of the model resembles the one in Section 3.4.1. However, the emphasis here is on "productive" government spending in creating the "endogenous" dynamics for growth. Therefore, I assume that the government has a balanced budget every period.

Households

Consider an overlapping generations model where individuals live for two periods and a new generation is born every period. Denote the number of people born at time t by n_t. The utility derived from consumption of an agent belonging to generation t is represented by the function:

$$U_t(c_{1,t}, c_{2,t+1}) = u(c_{1,t}) + \frac{1}{(1+\rho)} u(c_{2,t+1}) \tag{4.1}$$

with

$$u(c) = (c^{1-\gamma})/(1-\gamma)$$

and $\gamma > 0$ where $c_{1,t}$ and $c_{2,t+1}$ denote young and old period consumption of a person born in period t, respectively. Observe that $(c) = ln\,(c)$ when $\gamma = 1$. Set

$$U_t(c_{1,t}, c_{2,t+1}) = ln(c_{1,t}) + \frac{1}{(1+\rho)} ln(c_{2,t+1})$$

Agents work in the first period of their lives and are retired when they are old. A young agent supplies inelastically one unit of labor. The wage rate in period t is represented by w_t and the interest rate by r_t. The government sets a proportional tax, τ, equally on all types of income. Hence, young consumption is:

$$c_{1,t} = (1-\tau) w_t h_t - s_t \tag{4.2}$$

Similarly, old consumption will be:

$$c_{2,t+1} = (1 + (1 - \tau)r_{t+1})s_t \tag{4.3}$$

Here, s_t represents savings of the young generation at time t.

Maximization of the utility function subject to the constraints defined in Equation 4.2 and Equation 4.3 and $(c_{1,t}, c_{2,t+1}) \geq 0$ yields the following first order condition:

$$c_{2,t+1} = \left(\frac{1 + (1 - \tau)r_{t+1}}{1 + \rho}\right) c_{1,t} \tag{4.4}$$

Plugging the above expression into Equation 4.3, we get the following relation:

$$s_t = \frac{c_{1,t}}{(1 + \rho)}$$

From Equations 4.2 and 4.3, we get the intertemporal budget constraint from which it is possible to derive young consumption and savings at any period t as a function of wages:

$$c_{1,t} + (1 + (1 - \tau)r_{t+1})^{-1} c_{2,t+1} = (1 - \tau)w_t h_t$$

$$c_{1,t} = \frac{(1 - \tau)(1 + \rho)}{(2 + \rho)} w_t h_t \tag{4.5}$$

$$s_t = \frac{(1 - \tau)}{(2 + \rho)} w_t h_t \tag{4.6}$$

Production

The representative firm of the economy produces output Y_t according to the technology,

$$Y_t = AX K_t^{\alpha} L_t^{1-\alpha} \quad AX > 0, \;\; \alpha \in (0, 1) \tag{4.7}$$

where K_t and L_t denote the amount of physical capital and effective labor at time t, respectively.

Profit maximization by the firm yields:

$$r_t = \alpha A X K_t^{\alpha-1} L_t^{1-\alpha} \tag{4.8}$$

$$w_t = (1-\alpha) A X K_t^{\alpha} L_t^{-\alpha} \tag{4.9}$$

Human capital accumulation

Members of the initial old generation are each endowed with k_0 units of physical and h_0 units of human capital. Individuals in subsequent generations are endowed with h_t units of human capital in their youth. Human capital accumulation is assumed to be fully public and its production function is of the form:

$$h_t = H(GE_{t-1}) \tag{4.10}$$

where GE_{t-1} is public expenditures on education in period $t-1$.

For analytical simplicity, we assume a linear form for the production function of the human capital in each period.

$$h_t = \lambda GE_{t-1}$$

The parameter λ here, can be interpreted as the effective rate of human capital investment.

Government in this set-up is assumed to have a balanced budget each period and it constantly finances human capital production by a constant amount of its total tax revenues. Therefore, in each period $GE_t = \psi T_t$, where T_t denotes the amount of tax revenues of the government at time t. The rest of the tax revenues $(1-\psi)T_t$, represents government non-education expenses, or simply government consumption, GC_t.

Under this setup, since government taxes all types of income by the same rate,

it is possible to write the following expression for h_t in each period:

$$\begin{aligned} h_{t+1} &= \lambda\psi T_t \\ &= \lambda\psi\tau Y_t \\ &= \lambda\psi\tau AX K_t^{\alpha} L_t^{1-\alpha} \end{aligned}$$

Equilibrium

Given k_0 and h_0, an equilibrium for the economy modeled is defined as a sequence of allocations $\{K_t, L_t, Y_t, h_t, c_{1,t}, c_{2,t+1}\}_{t=0}^{\infty}$ and prices $\{w_t, r_t\}_{t=0}^{\infty}$ such that:

(i) given w_t and r_{t+1}, the allocation $(c_{1,t}, c_{2,t+1})$ solves the problem of the representative agent of generation t.

(ii) given w_t and r_t, the allocation (Y_t, K_t, L_t), maximizes the representative firm's profits subject to the production technology.

(iii) $L_t = n_t h_t \quad n_t = \bar{n}$

(iv) $K_{t+1} = n_t s_t$

(v) $GE_t = \psi\tau(w_t h_t + r_t k_t)$, and

(vi) $h_{t+1} = \lambda GE_t$

The equilibrium condition for the evolution of the physical capital can be written in per-capita terms using the expressions for s_t and w_t:

$$\begin{aligned} K_{t+1} &= n_t s_t \\ &= \bar{n} s_t \\ &= \bar{n}\frac{(1-\tau)}{(2+\rho)} AX(1-\alpha)\frac{K_t^{\alpha}}{\bar{n}^{\alpha} h_t^{\alpha}} h_t \end{aligned}$$

Dividing the last line by $\bar{n}$, we get the evolution of the physical capital in per-

capita terms:

$$\frac{K_{t+1}}{\bar{n}} = k_{t+1} = \frac{1-\tau}{2+\rho} AX(1-\alpha) k_t^{\alpha} h_t^{1-\alpha} \tag{4.11}$$

Now, rewriting the accumulation process of human capital in equilibrium:

$$\begin{aligned} h_{t+1} &= \lambda\psi\tau AX K_t^{\alpha} L_t^{1-\alpha} \\ &= \lambda\psi\tau AX K_t^{\alpha} \bar{n}^{1-\alpha} h_t^{1-\alpha} \\ &= \lambda\psi\tau AX \frac{K_t^{\alpha}}{\bar{n}^{\alpha}} \bar{n} h_t^{1-\alpha} \\ &= \lambda\psi\tau AX k_t^{\alpha} \bar{n} h_t^{1-\alpha} \end{aligned}$$

it becomes possible to reach to the ratio of human capital to physical capital.

$$\frac{h_{t+1}}{k_{t+1}} = \frac{\lambda\psi\tau\bar{n}(2+\rho)}{(1-\tau)(1-\alpha)} \tag{4.12}$$

Now, it is possible to use Equation 4.12 to get an expression for the path of physical capital:

$$\frac{k_{t+1}}{k_t} = \frac{(1-\tau)}{2+\rho} AX(1-\alpha) \left(\frac{k_t}{h_t}\right)^{\alpha-1} \tag{4.13}$$

Inserting in the expression for k_t/h_t from equation (9), we get the rate of growth of physical capital on the balanced growth path, displays no transition, and is always equal to:

$$\frac{k_{t+1}}{k_t} = \gamma = \frac{(1-\tau)}{2+\rho} AX(1-\alpha) \left[\frac{(1-\tau)(1-\alpha)}{\lambda\psi\tau\bar{n}(2+\rho)}\right]^{(\alpha-1)} \tag{4.14}$$

In order to see how a change in fiscal policy, specifically a change in the income tax rate τ affects the growth rate γ, we carry out the following partial derivation:

$$\frac{\partial\gamma}{\partial\tau} = AX(1-\alpha)^{\alpha}(2+\rho)^{-\alpha}(\lambda\psi\bar{n})^{1-\alpha} \frac{-\alpha(1-\tau)^{\alpha-1}\tau^{\alpha-1} - (\alpha-1)\tau^{\alpha-2}(1-\tau)^{\alpha}}{(\tau^{\alpha-1})^2} \tag{4.15}$$

From Equation 4.15, it is easy to see that $\frac{\partial\gamma}{\partial\tau} \geq 0 \iff \tau \leq (1-\alpha)$. That is, as long as the tax rate is smaller than the output elasticity of human capital, it is

possible to create further gains in growth rate of the economy, γ by increasing the tax rate. Therefore, the growth-maximizing level of tax rate is $\tau = (1 - \alpha)$. The analysis here indicates that when government expenditures has a "productive" component that is included as an argument in the production of accumulative factors in the economy, the disincentives due to higher tax rate are balanced against the benefits of public expenditures on human capital investment.

4.4 The Algebraic Structure of the Endogenous Growth Model

The model is an endogenous growth version of the model described in Chapter 3. The endogeneity is due to the accumulation of capital through a human capital production function as outlined in Section 4.2.2. So, each agent entering the labor force is endowed with a given level of human capital which can be assumed as an output of an education process during childhood. The period of education is assumed to bring no utility to the agent and there are no intentional bequest motives.[9]

Section 3.4.1 of Chapter 3 introduced the analytical structure of a large-scale OLG model under "exogenous growth" setup. In this section, I shall elaborate on the "endogeneity" of the model and direct the reader to Section 3.4.1 of Chapter 3 for "overlapping" parts of the model.

4.4.1 Human Capital Accumulation

As in Chapter 3, Section 3.4.1, subscript t denotes the time period and gl represents the age group.

[9]No intentional bequest motives in the form of physical capital is a strong simplification given the effect of intergenerational altruism on the capital accumulation of the economy and given the behavior of a typical Turkish household. However, the model, as will be illustrated, incorporates unintentional bequests in the form of human capital of the parent.

At any date t, n_{1t} individuals enter the workforce and the basic education system endows each of these entrants with a human capital stock $h_{1,t}$ which is generated according to an accumulation function of the form:

$$h_{1,t} = H(h_{1,t+1}, GE_{t-1}) \tag{4.16}$$

where GE_{t-1} is public expenditures on education in period $t-1$.[10] The existence of $h_{1,t-1}$ in the accumulation function represents an unintentional bequest behavior and basically constitutes the "private" portion of education. Empirically, Borjas (1992) presents evidence for human capital externalities by showing that average level of human capital of past generations positively affect the current generations' productivity level.

One way to interpret the sequence of human capital endowment is as follows: the time until an agent enters the workforce is the education period of learning and acquiring skills. During this period, individuals accumulate human capital according to the learning technology given in Equation 4.16 and by inelastically allocating their time to learning. An agent, once endowed with the human capital, maintains that particular level throughout her lifespan, i.e. for an agent that is a member of generation t, $h_{gl+1,t+1} = h_{gl,t} \ \ \forall \ gl \in \{1, ...(GL-1)\}$.

As in the exogenous model, the economy consists of overlapping generations of finite-lived individuals who are assumed to have $GL = 30$ periods to live, starting form the date they enter the workforce. The number of periods the agent works to earn a given wage income is GW and is set equal to 24. In the last 6 periods of her life, the agent is assumed retired.

Following the specification of Saint-Paul and Verdier (1993), the human capital

[10]The generic formulation is adopted from Saint-Paul and Verdier (1993). Because the focus is on fiscal policy and the distinction between government productive and non-productive spending, the human capital accumulation function in Equation 4.16 is chosen.

accumulation function below is introduced:

$$h_{1,t} = \delta h_{1,t-1} + \lambda GE_{t-1} \tag{4.17}$$

where $(1-\delta)$ is the exogenously determined depreciation rate for human capital (skills) and λ measures the rate at which government spending on education enhances the human capital of an agent entering the workforce at time t.[11]

Households

The specific form of the life-time utility function over the consumption composite $cc_{g,t}$ throughout the lifespan of an individual is of the *constant elasticity of substitution* form. For an agent entering the workforce at time t:

$$U_t = \frac{1}{1-\frac{1}{\gamma}} \sum_{gl=1}^{30} \beta^{gl-1} cc_{gl,t+gl-1}^{1-\frac{1}{\gamma}} \tag{4.18}$$

with the discount factor β and the intertemporal elasticity of substitution γ.

The optimization problem of the representative agent is due to the physical wealth accumulation conditions. Each agent, following the education period enters the workforce with zero level of initial physical assets and a given level of human capital. On the other hand, current period budget constraint of a member of the workforce whose living the gl^{th} period of her life is:

$$a_{gl+1,t+1} - a_{gl,t} = (1-\tau_{i,t})[(1-\tau_{w,t})w_t h_{gl,t} + (1-\tau_{r,t})r_t a_{gl,t}] - cc_{gl,t} \tag{4.19}$$

where $a_{gl,t}$ is the physical wealth asset of the individual, $(1-\tau_{w,t})w_t h_{gl,t}$ is her (after-tax) wage income and $(1-\tau_{r,t})r_t a_{gl,t}$ is the (after-tax) profit income. $\tau_{i,t}$ is the wage rate applied to "total disposable income" of the agent[12]

[11] With respect to the discussion in Section 4.2.2, such a specification of the human capital production function creates a dynamic externality between generations, which leads to a sustained growth path despite constant returns to scale technology of the economy. Thus, human capital accumulation in this model constitute the ultimate driving force of growth.

[12] The set of taxation types in the model is restricted to involve the "income taxes". For calibration of total tax revenues of the government in the base-period, a tax $\tau_{i,t}$ is applied to both types of incomes.

The Production Sector

Firms face competitive input and output markets to maximize profits. It is now the total physical capital and total human capital that serve as the inputs of production. The production technology is represented by a Cobb-Douglas form[13]

$$Y_t = AK_t{}^{\alpha}L_t{}^{1-\alpha} \tag{4.20}$$

In Equation 4.20, L is the total efficiency labor. It is given by the summation of human capital factor for each cohort of the labor force, multiplied by the corresponding population, $L_t = \sum_{gl=1}^{24} h_{g,t}n_{g,t}$.

The factor demands then, are obtained from the first-order conditions of the profit maximization problem of the representative firm:

$$w_t = (1-\alpha)AK_t{}^{\alpha}L_t{}^{-\alpha} \tag{4.21}$$

$$r_t = \alpha AK_t{}^{\alpha-1}L_t{}^{1-\alpha} \tag{4.22}$$

Government

As a modification to the specification of the government sector in Chapter 3, the distinction between the government non-productive and productive spendings is put forward. Since public sector now invests in education, it has to make an allocation of its revenues into the process of human capital accumulation, GE_t and government consumption, GC_t. There are taxes on wage and profit incomes. The government also pays the interest on its debt outstanding and borrows to finance any access of expenditures over current revenues. The government's single-period budget identity

[13]Cobb-Douglas function in a numerical model is regarded as a plausible specification. Stokey and Rebelo (1995), for instance report that the elasticities of substitution in production are rather insignificant for the quantitative implications.

then, is given by:

$$B_{t+1} - B_t = rB_t + GC_t + GE_t - T_t \tag{4.23}$$

In Equation 4.23, T_t denotes the aggregate tax revenues and B_t is the outstanding stock of government debt, as usual. Here, GC_t and GE_t add up to total government expenditures (net of taxes), G_t.

As in Chapter 3, the government collects taxes through wage income, profit income and "disposable" income:

$$\begin{aligned} T_t &= \tau_{i,t}[\sum_{gl=1}^{24}(1-\tau_{w,t})w_t h_t n_{gl,t} + \sum_{gl=1}^{30}(1-\tau_{r,t})r_t a_{gl,t} n_{gl,t}] \\ &+ \tau_{w,t}\sum_{gl=1}^{24} w_t h_{gl,t} n_{gl,t} + \tau_{r,t}\sum_{gl=1}^{30} r_t a_{gl,t} n_{gl,t} \end{aligned} \tag{4.24}$$

The equations governing the behavior of the intermediary and the foreign sector are the same as displayed in Chapter 3. For the sake of completeness of the general picture I put some of the equations representing the behavior of intermediary and the foreign sector here, together with the equilibrium conditions.

Aggregation and Equilibrium Conditions

As narrated in Chapter 3, I introduce an intermediary to ensure that demand and supply of loanable funds are equated through the intermediary's revenues and its expenditures. The revenues come from the savings of domestic households and foreigners, interest earnings from being the sole lender to the government and rental earnings out of physical capital used in production:

$$RI_t = {S_t}^P + r_t B_t + r_t K_t + {S_t}^F \tag{4.25}$$

The expenditures of the intermediary compose of additions to physical capital stock of production $(K_{t+1} - K_t)$, additions to public sector debt stock $(B_{t+1} - B_t)$,

and interest payments on its debt to domestic wealth holders ($r_t A_t$) and to foreigners ($r_t {BI_t}^F$):

$$EI_t = (K_{t+1} - K_t) + r_t A_t + r_t {BI_t}^F + (B_{t+1} - B_t) \tag{4.26}$$

The resource constraint on physical capital implies that $RI_t = EI_t$ in equilibrium.

The output of the economy has to be equal to the summation of private consumption $CP_t = \sum_{gl} cc_{gl,t} n_{gl,t}$, government expenditures $G_t = GE_t + GC_t$, aggregate investments ($I_t = K_{t+1} - K_t$) and the net exports:

$$Y_t = CP_t + G_t + I_t + E_t - M_t \tag{4.27}$$

CP_t in Equation 4.27, on a composite good CC_t which is a *Constant Elasticity of Substitution*(CES) function of the domestic commodity DC_t and imports M_t. Likewise, export demand E_t, is generated through a *Constant Elasticity of Transformation* (CET) production function where together with the domestic commodity DC_t it forms total output Y_t.

The steady-state equilibrium for the economy is a sequence of allocations and prices such that (i) given the prices, the consumption and savings decisions of agents are derived according to the maximization of the intertemporal utility function subject to the lifetime budget constraints, (ii) given the prices, the representative firm maximizes profits subject to the production technology, (iii) given the ratio of government education expenditures to the total government (non-interest) spending, the government satisfies its budget constraint, (iv) the Armingtonian CES and CET functions determine the level of import demand and export supply, (v) human capital accumulation is governed by the production technology, using the parent's human capital and government education expenditures as inputs, (vi) the equilibrium in the goods market and the loanable funds market, together with the aggregation conditions

satisfied, (vii) the effective wage rate and the interest rate are constants. In steady-state, equilibrium would be held at a constant growth rate.

4.4.2 Calibration

The calibration procedure followed for the endogenous growth model with a distinction on government productive and non-productive expenditures is quite similar to the calibration methodology described in Chapter 3, Section 3.4.2. However, the endogenous growth model incorporates features that do not exist in the exogenous model and I shall briefly describe these *points* in order to provide a clear understanding of the calibration and the choice of parameter values under the endogenous growth setup.

In the exogenous growth model of Chapter 3, Section 3.4.2, while bringing the economy from year 1990 to the base-period (2002-2003) of simulation environment, the variable representing the government total expenditures is controlled to be able to reproduce the historically realized trajectory of the public sector balances. Here, since public investment on education enters as an input to the production of human capital, it is necessary to decompose the path of total government spending during 1990s into its productive and non-productive components. Table 4.1 displays the relative behavior of certain government expenditure items during the decade. The information provided by the table is used to replicate the behavior of government productive and non-productive expenditures in 1990s and to calibrate the share of government education expenditures in the base-period of the model.[14]

The human capital variable h_t, is first produced as an *index* at the steady-state growth path of the economy. Once the amount of government educational spending and

[14]Note that the parameter representing the share of government productive spending is one of the crucial parameters of the model since the fiscal policy alternatives analyzed, inevitably depend on the choice of the government funds available for bringing about the accumulative factors of production.

	1990	1991	1992	1993	1994	1995	1996
As Ratio of GNP (%)							
Public Revenues	14.20	15.60	16.10	17.90	19.30	17.90	18.20
Public Expenditures	17.20	20.90	20.40	24.60	23.20	22.00	26.40
Interest Payments on Total Debt	3.50	3.80	3.70	5.80	7.70	7.30	10.00
Government Expenditures (Net of Interest Payments)	13.70	17.10	16.70	18.80	15.50	14.70	16.40
Debt Stock	47.06	48.95	52.72	55.54	71.18	60.71	64.95
Domestic Debt Stock	14.55	15.50	17.76	18.03	20.66	17.53	21.32
Primary Balance	0.50	-1.50	-0.60	-0.80	3.80	3.30	1.80
Government Education Expenditures as Ratio of (%)							
Public Expenditures	18.8	19.3	19.7	16.6	13.4	12.2	11.0
Public Expenditures (Net of Interest Payments)	23.60	23.53	24.06	21.72	20.06	18.26	17.71
Gross National Product	3.23	4.02	4.02	4.08	3.11	2.68	2.90

	1997	1998	1999	2000	2001	2002
As Ratio of GNP (%)						
Public Revenues	19.80	22.10	24.20	26.60	28.70	28.10
Public Expenditures	27.40	29.20	35.90	37.20	44.90	42.60
Interest Payments on Total Debt	7.70	11.50	13.70	16.30	22.90	28.60
Government Expenditures (Net of Interest Payments)	19.70	17.70	22.20	20.90	22.00	14.00
Debt Stock	66.23	70.41	85.49	89.16	147.58	
Domestic Debt Stock	21.79	22.24	29.61	29.23	68.47	
Primary Balance	0.10	4.40	2.00	5.70	6.70	
Government Education Expenditures as Ratio of (%)						
Public Expenditures	11.1	11.1	11.2	9.9	8.6	
Public Expenditures (Net of Interest Payments)	15.44	18.31	18.11	17.62	17.55	
Gross National Product	3.04	3.24	4.02	3.68	3.86	

Sources: SPO Main Economic Indicators

Table 4.1: Public Balances, 1990-2002

aggregate efficiency labor variables are known, it is easy to come up with a value for the effective rate of public educational investment, λ. The human capital depreciation rate, δ is set to 0.2, which is chosen to be higher then the values in the empirical findings of the studies on industrialized countries, documented to lie between 0.02-0.04 (Mérette (1998)).

The value of the parameters and initial quantities are tabulated in Table 4.2. The most important step in the calibration of the Turkish economy to base-period values of 2002-2003, is to bring the (calibration) stable path to the base-period by applying the shock on deteriorated fiscal balances. As interest rates correspond to marginal productivity of capital in the model, the increase in aggregate non-productive government expenditures in 1990s is reflected in the over-proportionate increase in government consumption variable, GC_t. While doing this, the ratio of government education expenditures to aggregate public spending and to GNP are determined by the historically realized values tabulated in Table 4.1.

Technology scale parameter, A	0.4534
Capital income share, α	0.495
Household discount factor, β	0.9775
Intertemporal elasticity of substitution, γ	2.00
Human capital depreciation rate, δ	0.20
Effective rate of public investment on education, λ	$3.65e^{-5}$
CES function shift parameter, *ac*	1.8989
"" *bc*	0.4091
CES function share parameter, v	-0.70
CET function shift parameter, *at*	1.9962
"" *bt*	0.6780
CET function share parameter, μ	1.50
Income tax rate, τ_i	0.1271
Wage Income tax rate, τ_w	0.0764
Interest rate, r	0.1099
Wage rate, w	0.5987
Debt stock ratio to GNP, *B/Y*	0.8258
Tax revenues ratio to GNP, *T/Y*	0.1679
Private consumption ratio to GNP, *CP/Y*	0.6357
Private savings ratio to GNP, *S/Y*	0.2524

Table 4.2: Calibration Results - Endogenous Growth Model

The rest of the calibration process follows the methodology described in Section 3.4.2 of Chapter 3. The calibrated value of total debt stock as a ratio to GNP for the base period 2002-2003 is 82.58%. Government's educational investment corresponds to 2.08% GNP and constitues 20.5% of total public expenditures. The minor differences with the calibration results Table 3.1 of Section 3.4.2 of Chapter 3 have to be attributed to the internal distinctive structure of the "endogenous growth" model of this chapter. The difference in the measure of efficiency labor units cause the endogeneously-determined interest rate to be 10.99% in this model. Moreover, the distinction between the productive and non-productive spending causes a slight difference in the ratio of total debt to output which is 83.27% in the exogeneous growth model of Chapter 3.

4.5 Policy Analysis

I shall now turn to the discussion on the investigation of fiscal policy alternatives on debt management and public expenditures on education, cohort welfare and growth for the Turkish economy. As the benchmark scenario, the current IMF-led austerity program driven by the objectives of attaining primary fiscal surpluses is chosen.

4.5.1 Primary Surplus Program (PSP)

In constructing the baseline scenario, I study the specified and the expected macroeconomic consequences of the current austerity program, as implemented under the supervision of the IMF. The distinguishing characteristics of the simulation is the attainment of the primary surplus targets as set out during the official implementation of the program. Given the current focus of the current austerity program on attaining significant fiscal surpluses on the non-interest budget, the scenario is distinguished as the "Primary Surplus Program" (PSP).

In order to keep maximum consistency for our model with the outlines of the current austerity program, the primary surplus objective is attained by reducing both types of the public expenditures in the model. The funds generated from the reduction of public non-interest expenditures are then channeled into reduction of the outstanding debt of the economy. In other words, to meet the ends of the program, the model is utilized to create just enough level of "government total expenditures" (G_t); to create a pre-determined level of primary surplus (amounting to 6.5% of GNP) in the first 5 periods of the model. The government expenditures then are allowed to recover by the gradual decrease (1% in every 5 years) in the required primary surplus ratio, reaching 1.6% in the long-run. Throughout the simulation analysis, no further policy shocks on tax revenues is assumed. The ratio of government education expenditures

to government total expenditures is kept constant at its value of the base year. The macro and fiscal results of "PSP" are given in Table 4.3. Figure 4.1 portrays total debt as a ratio to GNP of the alternative policy environments.

	"Primary Surplus Program (Standard Scenario)"							
	2004-2013		2014-2023			2024-2033		
Average annual (%) growth rate of								
GDP	4.12		3.61			3.57		
Private consumption	5.07		3.91			3.22		
Private savings	-2.57		-2.89			-3.00		
Capital stock	6.47		5.35			4.97		
Efficiency labor	2.01		2.00			2.19		
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
Key Macroeconomic Variables (As a ratio to GDP)								
Private consumption	0.6425	0.6486	0.6539	0.6584	0.6628	0.6705	0.6712	0.6712
Private savings	0.2366	0.2214	0.2068	0.1931	0.1804	0.1468	0.1370	0.1280
Private investment	0.3114	0.3066	0.3026	0.2846	0.2814	0.2774	0.2731	0.2743
Capital stock	4.6079	4.7130	4.8183	4.9236	5.0177	5.2812	5.3651	5.4443
Interest rate	0.1093	0.1082	0.1071	0.1061	0.1051	0.1022	0.1013	0.1003
Foreign Savings*	0.0972	0.1044	0.1117	0.1192	0.1270	0.1519	0.1606	0.1696
Fiscal Balances (As a ratio to GDP)								
Total debt stock	0.8139	0.8013	0.7876	0.7725	0.7709	0.7596	0.7537	0.7514
Interest on total debt	0.0874	0.0841	0.0809	0.0777	0.0760	0.0712	0.0695	0.0683
Government taxes	0.1666	0.1653	0.1639	0.1626	0.1614	0.1576	0.1563	0.1550
Government expenditures (net of interest payments)	0.1016	0.1003	0.0989	0.1126	0.1114	0.1076	0.1113	0.1100
Education expenditures	0.0208	0.0206	0.0203	0.0231	0.0228	0.0221	0.0228	0.0226
Primary balance	0.0650	0.0650	0.0500	0.0500	0.0500	0.0450	0.0450	0.0450

* Adjusted Current Account Deficit which equals: Merchandise trade deficit + interest payements abroad, not including other factor incomes

Table 4.3: Macroeconomic Balances - Primary Surplus Program (PSP)

The fiscal balance under "PSP", as illustrated in Table 4.3, reveals a "recovery" in the fiscal aggregates, following the base-year. Yet, the recovery cannot be considered as a "credible" one. As a ratio to GNP, total debt stock is brought down to 75.14% by period 2022-2023. The interest rate holds around 10.5% and the interest burden on the government of the outstanding debt stock only falls down to 6.83% from its base-year value of 9.07%.

The scenario suggests a negative growth rate of savings with -2.57% over the period 2004-2013 and -3.0% over the period 2024-2033. Such a path, together with government's primary surplus being channelled into debt and interest re-payments, the

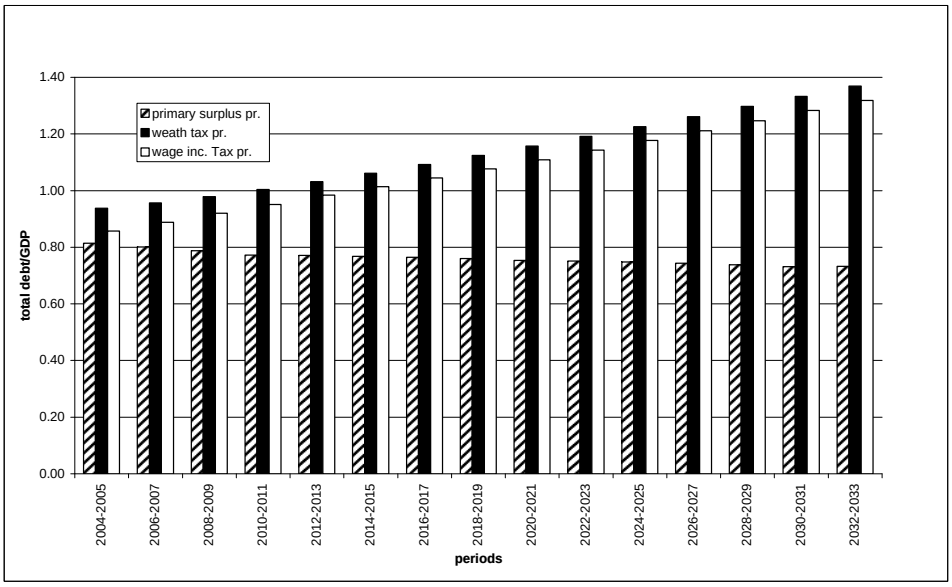

Figure 4.1: Total Debt Stock as a Ratio to GNP

growth rate of economy could only be kept at moderate levels. As public funds are reduced forcefully to attain primary surplus targets, "suply" side of the economy is affected adversely. The reduction in the public funds to produce efficiency labor causes the growth rate of total output to decrease. This occurs despite the revival of the funds to physical capital investment through reductions in the accumulation of domestic debt. Although the average growth rate the total capital stock during 2004-2013 is 6.47%, the efficiency labor could only grow by 2.01%, which formulates a 4.12% growth rate for GNP.

The strict attachment to fiscal targets to maintain warranted rates of primary surplus not only deprives the social/productive spheres of the economy from the most needed public funds to maintain the social capital investments on education, it also fails to generate a "credible" result on its main target. An inertial response in the path of the debt stock could only bring the ratio of total debt to GNP to 77.09% in five

periods.

Nevertheless, we do not observe a "parallel" decrease in total private consumption. The growth rate of consumption initially is higher than that of GNP. So, as a ratio of GNP, private consumption reaches to 67.12%, from its initial base-year value of 63.57%. Here, generations that have been participating the workforce both before and at the time of the implementation of "PSP", are the ones that have already passed through the education system. Thus, these generations have accumulated their human capital long ago. By the implementation of "PSP", funds that are available to education decreases, reducing the growth rate of aggregate amount of effective labor for production. So, generations that have already accumulated their skills, have the chance to earn relatively higher wage incomes. Moreover, these agents are the ones with relatively higher wealth-holdings. As the growth rate of capital is kept above the growth rate of the economy, profit income of these agents rise. Thus "older" agents are able to allocate more funds to consumption activities, as dictated by the first order condition of utility maximization. Such behavior of the agents gives further stimilus to aggregate consumption, decreasing aggregate savings. On the other hand, the squeezed funds to productive government expenditures are now able to contribute relatively less to production of human capital for the future generations, causing the relative earnings to decrease.

Summarizing up, the "PSP", the main objective of which is to generate a certain level of primary surplus through reductions in government expenditures and to allocate the additional funds to reduce the debt stock of the economy, suffers both from the initial come-down of the debt to GNP ratio and a trade-off on growth and fiscal targets.[15] There is also a trade-off between the welfare of the current and the welfare

[15]The question of how the economy would be able to transfer the gains in the fiscal balances into real production activities and growth creates an additional ambiguity of "PSP".

of future generations.

4.5.2 Wage Income Tax Program (WITP)

Given the path of the macroeconomy under "PSP", it would be pertinent to study various alternatives to mitigate the reduction in the availability of public funds to reproducible factors of production. In designing such alternatives of taxation, our objective is to automatically allocate the additional tax revenue not to debt reduction, but to educational funds exclusively.

	"Wage Income Taxation Program"							
	2004-2013		2014-2023			2024-2033		
Average annual (%) growth rate of								
GDP	4.54		4.43			4.41		
Private consumption	5.15		4.52			4.06		
Private savings	0.89		1.06			1.18		
Capital stock	6.02		5.60			5.46		
Efficiency labor	3.11		3.35			3.36		
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
Key Macroeconomic Variables (As a ratio to GDP)								
Private consumption	0.6272	0.6318	0.6352	0.6378	0.6396	0.6422	0.6421	0.6414
Private savings	0.2561	0.2466	0.2382	0.2305	0.2234	0.2029	0.1967	0.1908
Private investment	0.2822	0.2784	0.2756	0.2738	0.2766	0.2766	0.2777	0.2794
Capital stock	4.5851	4.6570	4.7212	4.7790	4.8317	4.9949	5.0486	5.1020
Interest rate	0.1112	0.1107	0.1098	0.1086	0.1073	0.1032	0.1019	0.1005
Foreign Savings*	0.0975	0.1050	0.1127	0.1207	0.1290	0.1554	0.1648	0.1744
Fiscal Balances (As a ratio to GDP)								
Total debt stock	0.8569	0.8881	0.9196	0.9515	0.9839	1.0763	1.1089	1.1424
Interest on total debt	0.0925	0.0944	0.0964	0.0985	0.1008	0.1066	0.1087	0.1108
Government taxes	0.1711	0.1704	0.1697	0.1689	0.1643	0.1617	0.1607	0.1598
Government expenditures (net of interest payments)	0.1461	0.1454	0.1446	0.1439	0.1393	0.1357	0.1348	0.1338
Education expenditures	0.033	0.0329	0.0327	0.0326	0.0286	0.028	0.0278	0.0276
Primary balance	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250

* Adjusted Current Account Deficit which equals: Merchandise trade deficit + interest payements abroad, not including other factor incomes

Table 4.4: Macroeconomic Balances - Wage Income Taxation Program (WITP)

The first alternative relies on the wage income taxation, and increases the wage income tax rate by 10% over the current rate of 7% for five consequtive modelling periods (that would amount to a calendar period of 10 years), staring with the period representing 2002-2003. Such a policy generates an additional 10% wage-income tax revenue each period during its implementation. There are two main hypotheses

underlying this experiments: First, the policy environment is "credible". In other words, the government succeeds in chanelling the additional monies into investments in education, still does not change its behavior on non-productive spending. Secondly, it is assumed that the policy shocks are unexpected; but once put in operation, the agents are informed on the duration and magnitude. Specific to the experiments carried out in this study, every generation of finite lifetimes in the model is assumed to take its life-time decisions of consumption and savings while the policy remains active. Thus, the transitional path analysis here does not take into consideration the generations that might enjoy possible policy changes in the context of debt-sustainability or government solvency in the future.

Table 4.4 reports on the macroeconomic balances under "WITP". The general equilibrium results as deviations from the benchmark scenario are given in Table 4.5. Figure 4.2 portrays the growth path in comparison to "PSP".

Under the "WITP", there are significant "gains" on the production side. As the growth rate of savings turns to be positive, the growth rate of capital stock is well above the rate under the "PSP". The growth rate of the economy stays around 4.45% on average, in period 2004-2033 compared with the 3.75% of the "PSP".

As currently young generations on wage income feel the effect of distortionary taxes on their budgets, they tend to increase their savings, causing to stay quite above their level under "PSP" (See Table 4.5). However, the increase in savings is not reflected as accumulations to total stock of capital. Since the government is now running a much lower level of primary surplus (2.5% as a ratio to GNP), the public sector borrowing requirement increases each period. Thus, although total asset accumulation of the

	EXP1, "WITP "							
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
GDP	0.9988	1.0002	1.0036	1.0089	1.0165	1.0403	1.0484	1.0569
Private Consumption	0.9751	0.9743	0.9749	0.9774	0.9810	0.9964	1.0030	1.0100
Private Savings	1.0812	1.1140	1.1560	1.2044	1.2588	1.4379	1.5053	1.5755
Total Assets	1.0027	1.0063	1.0108	1.0165	1.0234	1.0508	1.0618	1.0737
Capital Stock	0.9939	0.9883	0.9834	0.9793	0.9788	0.9839	0.9866	0.9905
Efficiency Labor	1.0037	1.0120	1.0239	1.0388	1.0549	1.0987	1.1128	1.1264
Total Wage Income	0.9879	0.9709	0.9577	0.9475	0.9394	0.9211	0.9160	0.9113
Total Profit Income	1.0077	1.0183	1.0317	1.0471	1.0629	1.1108	1.1285	1.1456
Foreign Savings	1.0015	1.0059	1.0128	1.0221	1.0326	1.0645	1.0757	1.0867
Fiscal Balances								
Total Taxes	1.0256	1.0308	1.0389	1.0478	1.0348	1.0674	1.0780	1.0897
Total Expenditures (net of interest payments)	1.4360	1.4498	1.4672	1.2896	1.2711	1.3212	1.2788	1.2952
Education Expenditures	1.5830	1.5989	1.6189	1.4236	1.2711	1.3212	1.2788	1.2952
Total Debt Stock	1.0515	1.1085	1.1719	1.2428	1.2974	1.4739	1.5427	1.6069

	EXP2, "WTP "							
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
GDP	1.0111	1.0301	1.0479	1.0649	1.0821	1.1294	1.1446	1.1598
Private Consumption	0.9574	0.9639	0.9724	0.9826	0.9934	1.0292	1.0421	1.0553
Private Savings	1.2158	1.3070	1.3966	1.4857	1.5757	1.8634	1.9700	2.0813
Total Assets	1.0056	1.0150	1.0273	1.0418	1.0581	1.1152	1.1365	1.1588
Capital Stock	0.9770	0.9776	0.9806	0.9854	0.9943	1.0254	1.0365	1.0487
Efficiency Labor	1.0456	1.0844	1.1184	1.1490	1.1756	1.1994	1.2613	1.2800
Total Wage Income	1.0111	1.0301	1.0479	1.0649	1.0821	1.1294	1.1446	1.1598
Total Profit Income	1.0407	1.0698	1.0978	1.1258	1.1516	1.2283	1.2550	1.2814
Foreign Savings	1.0213	1.0433	1.0645	1.0851	1.1044	1.1570	1.1736	1.1895
Fiscal Balances								
Total Taxes	1.0232	1.0464	1.0684	1.0891	1.1096	1.1667	1.1856	1.2047
Total Expenditures (net of interest payments)	1.4291	1.4676	1.5049	1.3364	1.3646	1.4467	1.4082	1.4339
Education Expenditures	1.4291	1.4676	1.5049	1.3364	1.3646	1.4467	1.4082	1.4339
Total Debt Stock	1.1647	1.2293	1.3021	1.3838	1.4478	1.6715	1.7578	1.8390

	EXP3, "HP "							
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
GDP	1.0059	1.0189	1.0341	1.0512	1.0710	1.1379	1.1629	1.1895
Private Consumption	0.9620	0.9641	0.9681	0.9742	0.9819	1.0135	1.0267	1.0415
Private Savings	1.1576	1.2283	1.3096	1.4007	1.5020	1.8751	2.0279	2.1941
Total Assets	1.0046	1.0114	1.0206	1.0319	1.0455	1.0989	1.1210	1.1453
Capital Stock	0.9884	0.9888	0.9914	0.9959	1.0051	1.0434	1.0594	1.0779
Efficiency Labor	1.0233	1.0493	1.0777	1.1084	1.1397	1.2388	1.2741	1.3101
Total Wage Income	1.0070	1.0187	1.0303	1.0419	1.0536	1.0938	1.1092	1.1254
Total Profit Income	1.0225	1.0422	1.0646	1.0891	1.1140	1.1984	1.2305	1.2638
Foreign Savings	1.0109	1.0254	1.0420	1.0606	1.0800	1.1425	1.1647	1.1871
Fiscal Balances								
Total Taxes	1.0125	1.0282	1.0467	1.0661	1.0876	1.1610	1.1882	1.2171
Total Expenditures (net of interest payments)	1.3140	1.3394	1.3679	1.2131	1.2397	1.3301	1.3029	1.3363
Education Expenditures	1.8799	1.9162	1.9570	1.7356	1.7736	1.9030	1.8640	1.9117
Total Debt Stock	1.0941	1.1391	1.1894	1.2457	1.2843	1.4186	1.4702	1.5157

Table 4.5: General Equilibrium Results - Ratio of Deviation from the Primary Surplus Program

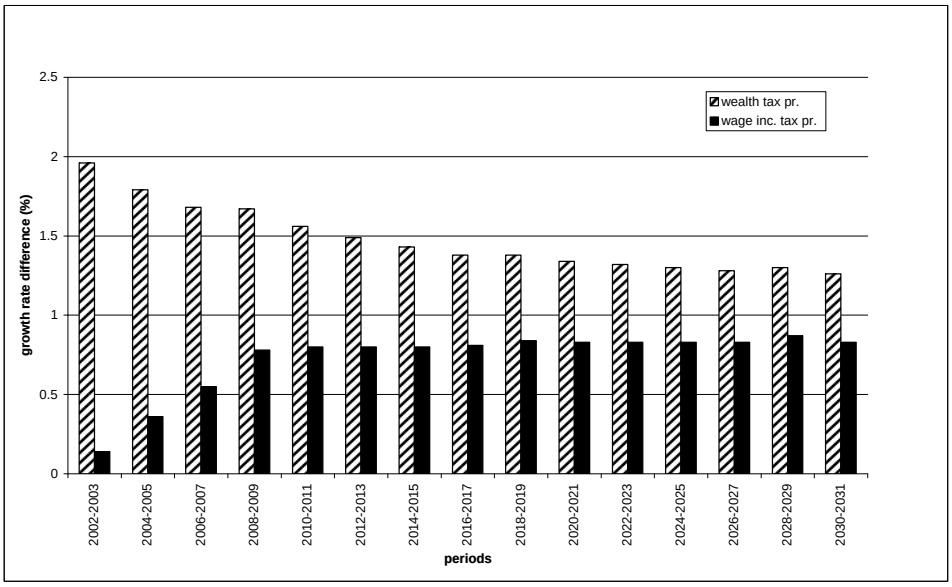

Figure 4.2: Growth Rate Differences w.r.t. Primary Surplus Program

economy continues to stay above its benchmark level, the crowding-out effect of PSBR on the funds available for production causes the total capital stock to stay below its level under "PSP". However, observe from Table 4.5 that as the "growth" effect dominates, the capital stock available for production revives.

The availability of additional funds to human capital accumulation increases the growth rate of the efficiency labor, and keeps total labor input for production well above the "PSP". However, the source of the additional funds is wage-income. So, as future generations enjoy the "possible gains" from the additional funds to education, the generations that are currently working suffer from losses. Thus, while the profit income level is above the "PSP", the wage-income follows a path below, causing the aggregate consumption variable to decrease w.r.t. "PSP" in the short-to-medium run, until the growth effects are in charge.

Looking at the fiscal balances on the other hand, we observe reversed results

of the "PSP". Although there is a gain in the accumulative factors of production, to stimulate growth, because the policy on government's spending behavior is kept loose, the growth of the tax revenues falls short of the government expenditures deteriorating fiscal balances. Consequently, the ratio of the total debt to GNP starts to increase from a level of 85.69% immediately after the introduction of the policy and reaches to 114.24% of GNP at the end of the 10^{th} period (year 2022-2023). This amount is 1.6 times greater than "PSP" level.

Given the acceleration in the rate of growth, the welfare analysis suggests considerable gains in the utility of the upcoming generations.[16] The methodology followed in creating a measure of welfare is the same as in Chapter 3 Section 3.4. If we denote $U_t\left(\{cc_{gl+t-1,t}\}_{gl=1}^{30}\right)$ as the lifetime utility of an agent entering the workforce at time t, by following the consumption path $\{cc_{gl+t-1,t}\}_{gl=1}^{30}$ under the benchmark scenario, it is possible to calculate the welfare gain (or loss) associated with a policy shock, θ as follows: If $\left\{cc'_{gl+t-1,t}\right\}_{gl=1}^{30}$ is the path of consumption of the agent after the shock, the measure of the welfare gain (loss) in compensating consumption units is the value of θ such that $U_t\left(\{cc_{gl+t-1,t}(1-\theta)\}_{gl=1}^{30}\right) = U_t\left(\left\{cc'_{gl+t-1,t}\right\}_{gl=1}^{30}\right)$. Figure 4.3 shows the welfare gain of all generations (generations entering the workforce before and after base-period 2002-2003) in comparison to "PSP". Figure 4.4 displays the deviations in the welfare of future generations with respect to "PSP". As followed from both figures, the "WITP" suggests increases in the welfare of both present and future generations. The increase in the welfare of each future generation is quite comparable since these generations are the ones that take advantage of the additional funds to education to add up to their efficiency, thus wage earnings. The relatively high growth rate on the other hand, prevents the compensating consumption units of the generations

[16]The assumption in carrying out the welfare analysis is that neither current nor the future generations involved in the analysis are obliged to bear any effects of the policy maneuvers to reduce the debt/GNP ratio.

who pay for the additional taxes, to turn negative. The relative loss of the wage income is made up for by the relative gain in the profit income through increased interest rate.[17]

Given the dismal outcome on the fiscal front, crucial questions remain: would there be

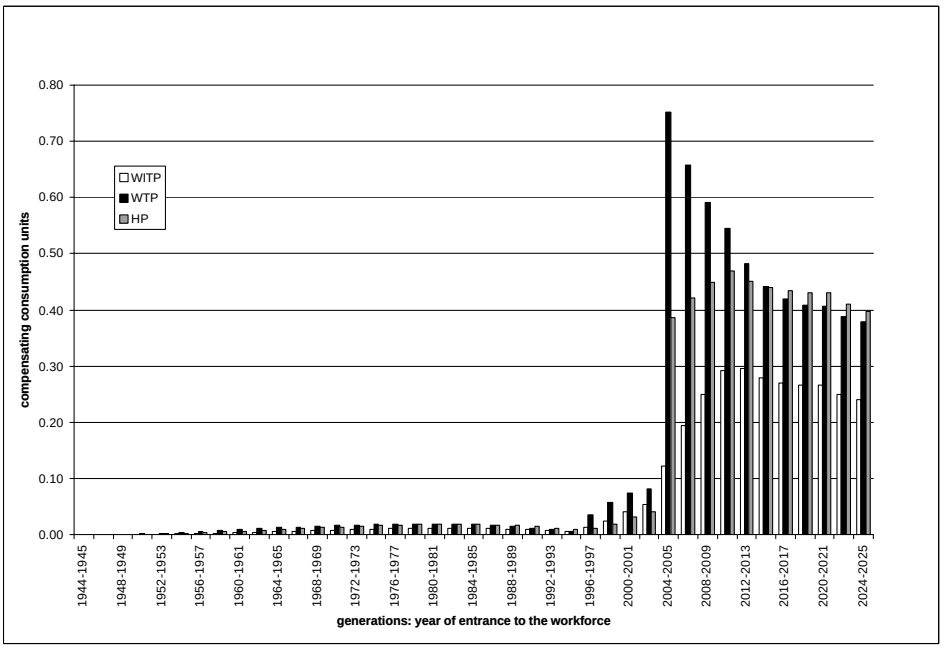

Figure 4.3: Welfare Analysis - All Generations

a critical level of additional tax revenues such that, while keeping the advantageous rate of growth and gains in aggregate output, will not allow the fiscal balances' deterioration to overcome the positive effects in the production side of the economy? What would be the main principle of a tax/expenditure reform program which would meet the servicing obligations of the outstanding debt, while not hampering the positive externalities on future production?

I now turn towards these questions and stimulate a fiscal expenditure-cum-tax reform strategy. Here, once more the focus is on implementing a selective tax reform, this time on the stock of assets (wealth income). The exclusive focus is to support

[17]Note once more that the interest rate is elementally equal to marginal productivity of capital in the model.

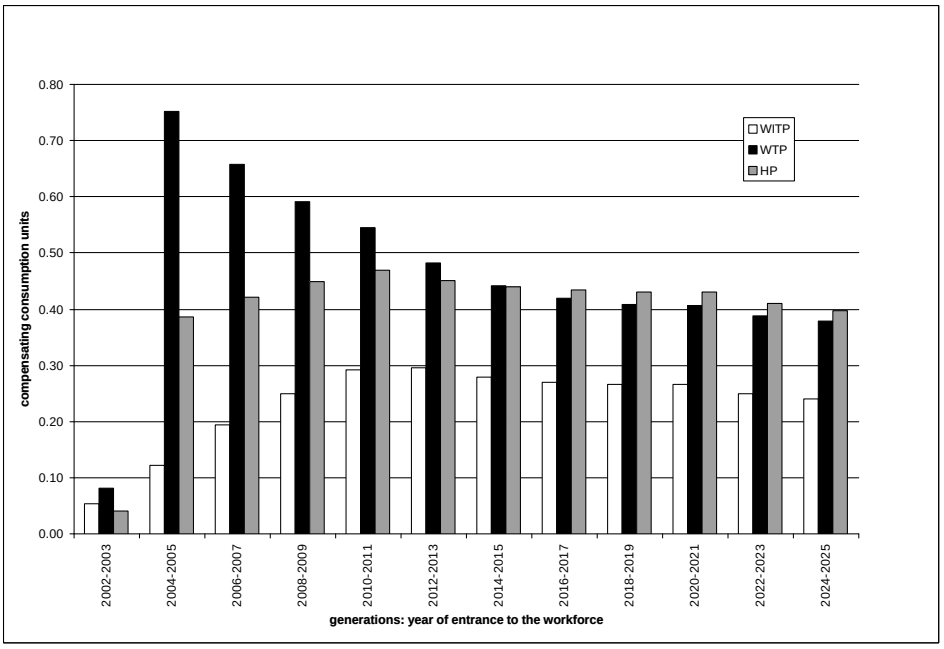

Figure 4.4: Welfare Analysis for Generations Entering the Workforce after Base Year

an increased public expenditure program addressed to finance public investments on education. The next sub-section investigates this policy scenario.

4.5.3 Wealth Tax Program (WTP)

In this scenario, a temporary tax on wealth incomes is introduced. The tax rate is set as 2% in the initial period (note that given the real life projection covers a period of two-years, such a policy shift becomes effective over 2002-2003). In the model, this amounts to an additional tax revenue of 10.3% of GNP and 59.7% of the current tax revenues. Like the "WITP", the additional tax revenues are included in the public funds used for accumulation of human capital.

The growth consequences of the policy are found to be quite strong. The growth rate of GNP is 1.5 percentage points higher than the "PSP" growth rate on average (See Table 4.6). Private consumption recovers more quickly then it does in "WITP",

after the tax shock. The aggregate saving variable reaches to 2-folds of its level under "PSP" by the period 2022-2023.

	"Wealth Tax Program "							
	2004-2013			2014-2023			2024-2033	
Average annual (%) growth rate of								
GDP	5.76			5.01			4.86	
Private consumption	5.09			5.15			5.49	
Private savings	4.38			3.52			2.99	
Capital stock	6.35			6.48			6.20	
Efficiency labor	5.37			3.75			3.58	
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
Key Macroeconomic Variables (As a ratio to GDP)								
Private consumption	0.6084	0.6069	0.6068	0.6075	0.6085	0.6110	0.6111	0.6107
Private savings	0.2845	0.2809	0.2756	0.2694	0.2627	0.2422	0.2358	0.2297
Private investment	0.3114	0.3066	0.3026	0.2846	0.2814	0.2774	0.2731	0.2743
Capital stock	4.4526	4.4724	4.5088	4.5561	4.6106	4.7946	4.8587	4.9231
Interest rate	0.1112	0.1107	0.1098	0.1086	0.1073	0.1032	0.1019	0.1005
Foreign Savings*	0.0982	0.1057	0.1134	0.1214	0.1296	0.1556	0.1646	0.1739
Fiscal Balances (As a ratio to GDP)								
Total debt stock	0.9376	0.9562	0.9785	1.0038	1.0314	1.1242	1.1574	1.1915
Interest on total debt	0.1042	0.1058	0.1074	0.1090	0.1107	0.1160	0.1179	0.1198
Government taxes	0.1686	0.1679	0.1671	0.1663	0.1655	0.1628	0.1619	0.1610
Government expenditures (net of interest payments)	0.1436	0.1429	0.1421	0.1413	0.1405	0.1378	0.1369	0.1360
Education expenditures	0.0295	0.0293	0.0291	0.0290	0.0288	0.0283	0.0281	0.0279
Primary balance	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250	0.0250

* Adjusted Current Account Deficit which equals: Merchandise trade deficit + interest payements abroad, not including other factor incomes

Table 4.6: Macroeconomic Balances - Wealth Taxation Program (WTP)

The path of debt accumulation, on the other hand, could not be brought under control more successfully than the previous tax reform program on wage incomes. Total debt stock as a ratio to GNP at the end of the 5^{th} period (year 2012-2013) is 103.14% and is 119.5% of GNP at the end of the 10^{th} period. These figures amount to 1.34 and 1.042 times higher than their levels under "WITP". Note that, the growth effect under "WTP" is quite powerful that the growth rate of total debt stock decreases in the medium-to-long run.

It could be observed from Figure 4.3 and Figure 4.4 that the older generations who have already accumulated substantial amount of assets are protected from welfare losses through the imposition of the wealth tax, by the associated growth effects of

the policy. Total profit income remains higher than both "PSP" and "WITP" levels. On the other hand, there are comparable gains in the welfares of future generations starting with the one entering the workforce in period 2004-2005. Following a period of transition, such gains are stabilized.

Given the complexity and variety of the above results, the natural questions to ask are what kind of a tax program would be more plausible and socially realistic? Is it possible to design a *compound* program that will not inherit the "unsustainable" characteristics of the fiscal balances and achieve comparable growth rates for both consumption and savings, thus growth?

The first alternative scenario analyzed here depends on the wage income taxation which would be the easiest to implement in the Turkish context. However a warranted rise 10% of tax burden for 10 (calendar) years on wage incomes could neither be politically realistic nor desirable from an egalitarian point of view. Moreover, note that altough both "WITP" and "WTP" generated comparable debt to GNP ratios, the revenue extracted from wage income taxation is much lower than the revenue obtained by wealth income taxation.[18] Taxation of wealth incomes while promises a more desirable outcome in terms of growth, still cannot keep the economy away from experiencing an unsustainable debt path.

4.5.4 Hybrid Program (HP)

Both the "WITP" and "WTP" provide comparable gains in the growth rate of the economy, since more funds are allocated for human capital accumulation through public education. But the path of the total debt stock turns out to be an exploding one under

[18]In a similar model, Voyvoda and Yeldan (2002) ask the question of by how much should the tax rate on wage incomes had to be increased to obtain the amount of revenue as in a "WTP" scenario with a 5% additional tax rate on wealth incomes. The finding is that the wage tax rate had to be increased by 60% over its current level in order to generate the same amount of revenue obtained form the implementation of wealth tax.

both taxation programs. There are two reasons for such an increasing behavior of the debt stock. One reason is that neither "WITP" not "WTP" include a strict primary surplus targets as in "PSP".[19] The other reason for rising debt stock is the distortionary effects of taxation on the capital accumulation of the economy. Although the efficiency labor units stay above the level under "PSP", the decrease in capital stock as a result of taxation of both types of income hinders the growth effect from creating enough resources to generate a stationary debt stock series in the economy.

The "HP" is a compounded program involving features of both taxation and fiscal prudence. Formally, a 1% tax on wealth incomes is imposed for one period (2002-2003). Accompanying this tax policy a 3.5% ratio of primary surplus to GNP is achieved. However, unlike the "PSP" scenario, in order for such a policy not to contract the government's funds available for accumulation of productive inputs, the surplus objective is mostly achieved through reductions in the government non-productive expenditures. For this, the share of government consumption variable, GC_t in total government expenditures (net of interest payments) is reduced by 10%. Such a treatment of the government sector keeps the government education expenditures at an amount of 3.8% of GNP on average in the first 10 periods of the model horizon. This value is greater than the value generated by additional (temporary) funds to education spending.

The revival of the funds to government educational spending causes the efficiency labor to grow with an average rate of 4.89%. As the additional taxes generated from wealth incomes is now less than the amount under "WTP", the distortionary effects are not that strong and with a growth rate of 6.87% on average, the capital stock recovers more quickly to generate the best growth performance among the alternative policy

[19]Primary surplus as a ratio to GNP is 2.5% under both "WITP" and "WTP".

scenarios (see Figure 4.2). The growth rate of output, is 5.66% on average for the first 5 periods of the model horizon, which generates a 7% higher GNP then the "PSP" in level terms at the end of the 5^th period. Likewise, the total assets, private savings and both wage and profit incomes show considerable gains in comparison to "PSP". Besides,

	"Hybrid Program "							
	2004-2013			2014-2023			2024-2033	
Average annual (%) growth rate of								
GDP	5.66			5.89			6.13	
Private consumption	5.49			5.14			5.07	
Private savings	3.78			3.86			3.98	
Capital stock	6.58			6.83			7.10	
Efficiency labor	4.71			4.88			5.08	
	1	2	3	4	5	8	9	10
	2004-2005	2006-2007	2008-2009	2010-2011	2012-2013	2018-2019	2020-2021	2022-2023
Key Macroeconomic Variables (As a ratio to GDP)								
Private consumption	0.6145	0.6137	0.6122	0.6102	0.6077	0.5972	0.5926	0.5877
Private savings	0.2723	0.2669	0.2619	0.2573	0.2530	0.2419	0.2389	0.2361
Private investment	0.3082	0.3100	0.3124	0.3154	0.3189	0.3326	0.3382	0.3443
Capital stock	4.5277	4.5738	4.6193	4.6644	4.7091	4.8426	4.8877	4.9334
Interest rate	0.1093	0.1082	0.1071	0.1061	0.1051	0.1022	0.1013	0.1003
Foreign Savings*	0.0977	0.1050	0.1125	0.1202	0.1281	0.1525	0.1608	0.1692
Fiscal Balances (As a ratio to GDP)								
Total debt stock	0.8854	0.8958	0.9059	0.9155	0.9245	0.9470	0.9528	0.9575
Interest on total debt	0.0968	0.0969	0.0971	0.0971	0.0972	0.0968	0.0965	0.0961
Government taxes	0.1677	0.1668	0.1659	0.1649	0.1639	0.1629	0.1619	0.1608
Government expenditures (net of interest payments)	0.1327	0.1318	0.1309	0.1299	0.1289	0.1258	0.1247	0.1236
Education expenditures	0.0389	0.0387	0.0384	0.0381	0.0378	0.0369	0.0366	0.0363
Primary balance	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350	0.0350
* Adjusted Current Account Deficit which equals: Merchandise trade deficit + interest payements abroad, not including other factor incomes								

Table 4.7: Macroeconomic Balances - Hybrid Program (HP)

a "sustainable" pattern of total debt stock as a ratio to GNP is attained. Starting from the base-year value of 82.58%, initially, this variable is observed to increase under the policy, reaching to 92.45% in the fifth period (year 2012-2013). Yet, it is stabilized at around 95% thereafter. Unlike the "WTP" that generates exploding paths for the ratio of debt stock to GNP, the "HP" involving less-distortionary effects and more funds to the accumulation of productive factors generate rather "smooth" path.

The welfare analysis of "HP" suggest further "comparable" results. Although the increased funds to education is not as high as the amount in "WTP", the pattern is more smooth in changing the patterns of accumulation of the capital stock and as the economy revives from the constraining effects of the debt management, the welfare

gain of the future generations are “equalized“. And as the economy continues to grow with the highest rate among the alternatives, the “HP” displays a comparable utility advantage to future generations.

4.5.5 Concluding Comments

The model employed in this Chapter studies the welfare and growth effects of various fiscal policy alternatives for the Turkish economy over 2000s. The current austerity program is criticized in its priority to targets of fiscal debt rather than growth, and an implicit preference for finance over industry. Furthermore the program is accused of a general indifference on its social welfare implications.

Thus, given the dubious macro-policy environment, I attempted to investigate the growth and welfare consequences of the current austerity program as well as the various alternatives of taxation and fiscal expenditures. To this end, I made use of an endogenous growth, overlapping generations model, calibrated to Turkish data over 1990s. The distinguishing characteristics of the model include a human capita-driven endogenous growth structure based on public-administered education investments; intertemporally optimizing agents; and an open current account.

The results indicated that a compound program with the objective of reviving the most-needed public funds for accumulation of productive factors in order to achieve sustained growth is likely to produce superior outcomes compared with the alternatives of fiscal prudence and distortionary taxation. Though wage wage income taxation is arguably the easiest to implement given the Turkish tax structure, it would likely to suffer from social and political constraints. Admitting that a tax program over wealth incomes would necessitate a strong bureaucracy and a well-administered taxation regime, the model results here emphasize that alternatives on fiscal programming do

exist. Nevertheless the model indicates that it is a "general equilibrium" approach to be followed in investigating the distortionary effects of taxation on accumulation patterns of the economy, the dilemmas that alternatives possess and the merits on the macroeconomic dynamics.

Chapter 5

Conclusions and Directions for Future Research

This chapter brings together the main hypotheses and the conclusions of the exogenous growth model of Chapter 3 and the endogenous growth model of Chapter 4 together, and demonstrates the feasible paths for future research.

The foregoing analysis clearly indicated the importance of fiscal policy choice on debt management, the destination and the mode of financing of public expenditures, and public investment on accumulative factors of production. In doing this, this dissertation utilized a general equilibrium framework that identified relationships of the fiscal policy alternatives to the production, accumulation, cohort welfare and growth. Given the experience of 1990s and given the macroeconomic picture, blurred by the constraints of debt servicing, this dissertation highlights the significance of growth and welfare implications of Turkey's recent process of transformation of its macro and fiscal structure.

I utilized a model of exogenous growth for Turkey in 1990s, in the OLG tradition to examine the effects of the current IMF-led austerity program driven by the objective of attaining primary fiscal surpluses. The model is then simulated to check for the sensitivity of the program to growth shocks. The results suggest that the current fiscal

program succeeds in constraining the explosive dynamics of debt accumulation, and yet, the path of aggregate public debt as a ratio to GNP displays significant degree of inertia and would be brought down only gradually and slowly.

Investigation of fiscal policy alternatives demands a more decomposed representation of the public sector. Given the dominating role of the public sector in constructing the patterns of production, accumulation and distribution in Turkey during 1990s, and choosing public investment in education to represent the government "productive" expenditures, an endogenous growth OLG model based on human capital accumulation was developed. The analysis of the current austerity program depending on attaining primary fiscal surpluses illustrates the trade-off on growth and fiscal targets. The examination of various taxation alternatives on the other hand, suggests the existence of comprehensive fiscal policy choices on public revenues and expenditures to mitigate the reductions in the public funds to education, and to relax the fiscal debt constraint simultaneously. The main message of the analysis is that alternatives of fiscal programming do exist, and it is highly important to carefully weigh the merits and dilemmas of each of the alternatives.

Given the degree of openness of the Turkish economy and the role of government debt management policies in the path of fiscal deepening in Turkey through 1990s, it is considerably important to incorporate the financial sector to the modeling framework described in this dissertation. There is already some work underway to add the financial markets to the large-scale OLG framework.[1] Overall, utilizing a model that accommodates the demand for money together with other financial assets, and that highlights the role of the public sector in financial markets would certainly add much to the analysis of this study.

[1] See Mérette (2000) and Naastepad (2002).

A further natural extension is to introduce heterogeneity among agents in terms of access to financial markets. This shall highlight the different income types and the resulting effects of fiscal policies on these differentiated incomes. One other type of heterogeneity that this dissertation implies is provided by the public versus private provision of education. Despite the large public content of education, the private funds provided by the parents is an important type of intentional bequest, affecting the accumulation and distribution patterns in an economy, both in the micro and in the macro scale.

Bibliography

Agénor, P.R. (2001) 'Fiscal policy, public debt sustainability, and solvency.' lecture notes, World Bank

Agénor, P.R., and P.J. Montiel (1999) *Development Macroeconomics* (Princeton, New Jersey: Princeton University Press)

Aghion, P., and C. Howitt (1998) *Endogenous Growth Theory* (Cambridge MA.: MIT Press)

Ahmed, S., and J.H. Rogers (1995) 'Government budget deficits and trade deficits: Are present value constraints satisfied in long-term data?' *Journal of Monetary Economics* 36, 351–374

Ahn, S., and P. Hemmings (2000) 'Policy influences on economic growth in OECD countries: an evaluation of evidence.' Working Paper 246, OECD

Akçay, C., E. Alper, and S. Özmucur (2002) 'Budget deficit, inflation and debt sustainability: Evidence from Turkey (1970-2000).' Technical Report, Boğaziçi University. mimeo

Akyüz, Y., and K. Boratav (2002) 'The making of the Turkish financial crisis.' Working Paper 158, UNCTAD

Armington, P.S. (1969) 'A theory of demand for products distinguished by place of origin.' *IMF Staff Papers* 16, 159–176

Arrow, K. (1962) 'The economic implications of learning by doing.' *Review of Economic Studies* 29, 155–173

Atiyas, I. (1995) 'Uneven governance and fiscal failure: The adjustment experience of Turkey.' In *Governance, Leadership, and Communication: Building Constituencies for Economic Reform,* ed. L. Frischtak and I. Atiyas (Washington D.C. World Bank)

Auerbach, A.J., and L.J. Kotlikoff (1987) *Dynamic Fiscal Policy* (Cambridge: Cambridge University Press)

Auerbach, A.J., R.P. Hageman, and G. Nicoletti (1989) 'The economic dynamics of ageing population: The case of four OECD countries.' *OECD Economic Studies.* Number 12

Azariadis, C. (1993) *Intertemporal Macroeconomics* (Cambridge, Massachusetts, USA: Blackwell Publisher)

Balkan, E., and E. Yeldan (1998) 'Financial liberalization in developing countries: The Turkish experience.' In *Financial Liberalization in Developing Countries,* ed. R. Medhora and J. Fanelli (Macmillan Press)

Barro, R.J. (1991) 'Economic growth in a cross section of countries.' *Quarterly Journal of Economics* 106, 407–433

Barro, R.J., and X. Sala-i Martin (1985) *Economic Growth* (Singapore: McGraw Hill)

Bascard, G., and A. Razin (1997) 'Indonesia's fiscal position: Sustainability issues.' In *Macroeconomic Issues Facing ASEAN Countries,* ed. J. Hicklin, D. Robinson, and A. Singh (Washington: International Monetary Fund)

Benhabib, J., and M. Spiegel (1994) 'The role of human capital in economic development: Evidence from aggregate cross-country data.' *Journal of Monetary Economics* 43, 143–174

Bils, M., and P. Klenow (2000) 'Does schooling cause growth?' *American Economic Review* 90, 1160–1183

Blanchard, O.J. (1985) 'Debts, deficits and finite horizons.' *Journal of Political Economy* 93, 223–247

—— (1990) 'Suggestions for a new set of fiscal indicators.' Working Paper 26531, OECD Economics and Statistics Department

Boratav, K. (2001) '2000-2001 krizinde sermaye hareketleri.' *İktisat, İşletme ve Finans* 186, 7–18

Boratav, K., and E. Yeldan (2002) 'Turkey, 1980-2000: Financial liberalization, macroeconomic (in)-stability, and patterns of distribution.' mimeo http://www.bilkent.edu.tr/ yeldane

Boratav, K., and O. Türel (1993) 'Turkey.' In *The Rocky Road To Reform,* ed. L. Taylor (Cambridge: MIT Press)

Boratav, K., E. Yeldan, and A. Köse (2000) 'Globalization, distribution and social policy: Turkey: 1980-1998.' Working Paper, No: 20, CEPA and The New School for Social Research

Boratav, K., O. Türel, and E. Yeldan (1996) 'Dilemmas of structural adjustment and environmental policies under instability: Post-1980 Turkey.' *World Development* 24(2), 373–393

Borjas, G.J. (1992) 'Ethnic capital and intergenerational mobility.' *Quarterly Journal of Economics* 107, 123–150

Bovenberg, A.L., and C. van Ewijk (1997) 'Progressive taxes, equity, and human capital accumulation in an endogenous growth model with overlapping generations.' *Journal of Public Economics* 64, 153–179

Buiter, W.H. (1981) 'Time preference and international lending and borrowing in an overlapping-generations model.' *Journal of Political Economy* 89, 769–797

___ (1985) 'Guide to public sector debt and deficits.' *Economic Policy: A European Forum* 1, 13–79

Buiter, W.H., and K.M. Kletzer (1991) 'Capital mobility, fiscal policy and growth under self-financing of human capital formation.' *Journal of Economic Dynamics and Control* 15, 215–244

___ (1995) 'Capital mobility, fiscal policy and growth under self-financing of human capital formation.' Working Paper 5120, NBER

___ (1998) 'Debt and taxes: Ponzi finance, dynamic efficiency and government solvency.' In *Market Behaviour and Macroeconomic Modelling,* ed. S. Brakman, H. Van Ees, and S. Kuipers (London: Macmillan Press)

Buiter, W.H., and U.R. Patel (1992) 'Debt, deficits and inflation: An application to the public finances of India.' *Journal of Political Economics* 47, 171–205

Buti, M., D. Franco, and H. Ongena (1998) 'Fiscal discipline and flexibility in emu: The implementation of the stability and growth pact.' *Oxford Review of Economic Policy* 14, 81–97

Caballé, J. (1995) 'Endogenous growth, human capital and bequests in a life-cycle model.' *Oxford Economic Papers* 47, 156–181

___ (1998) 'Growth effects of taxation under altruism and low elasticity of intertemporal substitution.' *The Economic Journal* 108, 81–97

Celasun, M. (2001) 'Gelişen ekonomilerin dış kaynak kullanımı ve finansal krizler.' *Doğu Batı* 4(17), 161–180

___ (2002) '2001 krizi, öncesi ve sonrası: Makroekonomik ve mali bir değerlendirme.' In *Küreselleşme, Emek Süreçleri ve Yapısal Uyum,* ed. A. Dikmen (Türk Sosyal Bilimler Derneği, Ankara: İmge Yay.)

Celasun, M., and D. Rodrik (1989) 'Debt, adjustment and growth: Turkey.' In *Developing Country Debt and Economic Performance, Country Studies,* ed. J. Sachs and S.M. Collins (Chicago and London, The University of Chicago Press)

Chalk, N., and R. Hemming (2000) 'Assessing fiscal sustainability in theory and practice.' Working Paper WP/00/81, IMF

Cizre-Sakallıoğlu, U., and E. Yeldan (2002) 'Turkey: Economy, politics and society in the post-crisis era.' mimeo

Corsetti, G., and N. Roubini (1991) 'Fiscal deficits, public debt and government solvency: Evidence from OECD countries.' *Journal of Japanese and International Economy* 5(4), 354–380

Şenses, F. (1994) 'The stabilization and structural adjustment program and the process of Turkish industrialization: Main policies and their impact.' In *Recent Industrialization Experience of Turkey in a Global Context,* ed. F. Şenses (Westprot, CT, Greenwood Press)

De La Fuente, A., and D. Domenech (2000) 'Human capital in growth regressions, how much difference does data quality make?' Technical Report, CSIC, Campus de la Universidad Autonome de Barcelona. mimeo

Diamond, P. (1965) 'National debt in a neo-classical growth model.' *American Economic Review* 55(5), 1126–1150

Durlauf, S.N., and D.T. Quah (1998) 'The new empirics of economic growth.' mimeo

Easterly, W., and S. Rebelo (1993) 'Fiscal policy and economic growth: An empirical investigation.' *Journal of Monetary Economics* 32, 417–458

Ekinci, N. (1998) 'Türkiye ekonomisinde gelişmenin dinamikleri ve kriz.' *Toplum ve Bilim* 77, 7–27

Ertuğrul, A., and F. Selçuk (2001) 'A brief history of Turkish economy, 1990-2000.' *Russian and East European Finance and Trade* 37(6), 54–75

Fernandez, R., and R. Rogerson (1995) 'On the political economy of education subsidies.' *Review of Economic Studies* 62, 249–262

Fischer, S. (1993) 'The role of macroeconomic factors in growth.' *Journal of Monetary Economics* 32, 485–512

Flavin, M.A., and J.D. Hamilton (1985) 'On the limitations of government borrowing: A framework for empirical testing.' Working Paper 1632, NBER

Fougère, M., and M. Mérette (1999) 'Population ageing and economic growth in seven OECD countries.' *Economic Modelling* 16, 411–427

Gençay, R., and F. Selçuk (2001) 'Overnight borrowing, interest rates and extreme value theory.' Discussion Paper 01-03, Bilkent University, Department of Economics

Gerson, P., and D. Nellor (1997) 'Phillippine fiscal policy: Sustainability, growth and savings.' In *Macroeconomic Issues Facing ASEAN Countries,* ed. J. Hicklin, D. Robinson, and A. Singh (Washington: International Monetary Fund)

Glomm, G., and B. Ravikumar (1992) 'Public vs. private investment in human capital: Endogenous growth and income inequality.' *Journal of Political Economy* 100, 818–834

—— (1997) 'Productive government expenditures and long-run growth.' *Journal of Economic Dynamics and Control* 21, 183–204

Grosman, G.M., and E. Helpman (1991) *Innovational Growth in the Global Economy* (Cambridge MA.: MIT Press)

Hakkio, C.S., and M. Rush (1991) 'Is the budget deficit too large?' *Economic Inquery* 29, 429–445

Husted, S. (1992) 'The emerging u.s. current account deficit in the 1980s: A cointegration analysis.' *Review of Economics and Statistics* 74, 159–167

Hviding, K., and M. Mérette (1998) 'Macronomic effects of pension reforms in the context of ageing: Olg simulations for seven OECD countries.' Technical Report 201, OECD Working Paper

International Monetary Fund (1996) *World Economic Outlook, May 1996: A Survey by the Staff of the International Monetary Fund* (Washington: World Economic and Financial Surveys)

—— (2000) 'Turkey: Selected issues and statistical appendix.' Country Report No. 00/14

Jensen, E.L., S.B. Nielsen, L.H. Pedersen, and L.H. Sorensen (1998) 'Tax policy, housing and labor market: An intertemporal simulations approach.' *Economic Modelling* 13, 355–382

Jones, E.L., and R.E. Manuelli (1992) 'Finite lifetimes and growth.' *Journal of Economic Theory* 58, 171–197

Kenç, T., and S. Sayan (2001) 'Demographic shock transmission from large to small countries: An overlapping generations CGE analysis.' *Journal of Policy Modeling* 23, 677–702

Kepenek, Y., and N. Yentürk (2000) *Türkiye Ekonomisi* (İstanbul: Remzi Kitabevi)

Keyder, N. (2003) 'The aftermath of the 2000 stabilization program and november 2000 financial crisis in Turkey.' *Russian and East European Finance and Trade* 37(5), 22–44

King, R.G., and S. Rebelo (1990) 'Public policy and economic growth: Developing neoclassical implications.' *Journal of Political Economy* 98, 126–150

Knudsen, M.B., L.H. Pedersen, T.W. Petersen, P. Stephensen, and P. Trier (1997) 'A prototype of dream (danish rational economic agents model).' mimeo

Köse, A., and E. Yeldan (1996) 'Çok sektörlü hesaplanabilir genel denge modellerinin veri tabanı üzerine notlar: Türkiye 1990 sosyal hesaplar matrisi.' *METU Studies in Development* 23, 59–83

—— (1998a) 'Dışa açılma sürecinde Türkiye ekonomisinin dinamikleri: 1980-1997.' *Toplum ve Bilim* 77, 45–67

—— (1998b) 'Turkish economy in 1990s: An assessment of fiscal policies, labor markets and foreign trade.' *New Perspectives on Turkey* 18, 57–80

Kotlikoff, L.J., and L.H. Summers (1981) 'The role of intergenerational transfers in capital accumulation.' *Journal of Political Economy* 89, 542–567

Krueger, A., and M. Lindahl (2001) 'Education for growth: Why and for whom.' *Journal of Economic Literature* 39, 893–922

Liu, K. (1994) 'Do capital income taxes always reduces growth?' *Public Finance Quarterly* 22, 383–396

Lucas, R.E. (1988) 'On the mechanics of economic development.' *Journal of Monetary Economics* 22, 293–326

Marin, J. (2000) 'Sustainability of public finances and utomatic stabilization under a role of budgetary discipline.' Working Paper 193, European Central Bank

McCallum, T.B. (1984) 'Are bond-financed deficits inflationary? a ricardian analysis.' *Journal of Political Economy* 92(1), 123–135

Mendoza, E., G. Milesi-Ferretti, and P. Asea (1997) 'On the effectiveness of tax policy in altering long-run growth: Harberger's superneutrality conjecture.' *Journal of Public Economics* 66, 99–126

Mérette, M. (1998) 'The effects of debt reduction on intergenerational equity and growth: The case of canada.' mimeo

—— (2000) 'Post-mortem of a stabilization plan: The collor plan in Brazil.' *Journal of Policy Modelling* 22, 417–452

Metin-Özcan, K., E. Voyvoda, and E. Yeldan (2001) 'Dynamics of macroeconomic adjustment in a globolized developing economy: Growth, accumulation and distribution, Turkey.' *Canadian Journal of Development Studies* 22, 217–253

Miller, S.M., and F.S. Russek (1997) 'Fiscal structures and economic growth at the state and local level.' *Public Finance Review* 25, No.2

Modigliani, F., and R. Brumberg (1954) 'Utility analysis and the consumption function: An interpretation of cross-section data.' In *Post-Keynesian Economics,* ed. K.K. Kurihara (New Brunswick, NJ: Rutgers University Press)

Naastepad, C.W.M. (2002) 'Trade-offs in stabilization: A real-financial CGE analysis with reference to india.' *Economic Modelling* 19, 221–224

Nelson, R.R., and E.S. Phelps (1966) 'Investment in humans, technological diffusion, and economic growth.' *American Economic Review* 56, 69–75

Ni, S., and X. Wang (1994) 'Human capital and income taxation in an endogenous model.' *Journal of Macroeconomics* 16, 493–507

Obstfeld, M., and K. Rogoff (1996) *Foundations of International Macroeconomics* (Cambridge: The MIT Press)

O'Connell, S.A., and S.P. Zeldes (1988) 'Rational ponzi games.' *International Economic Review* 29(3), 431–450

OECD (2000) 'Education at a glance.' Technical Report, OECD. Paris

Özatay, F. (1999) 'The 1994 currency crisis in Turkey.' *Policy Reform* 1(1), 1–26

Persson, T. (1985) 'Deficits and intergenerational welfare in open economies.' *Journal of International Economics* 19, 67–84

Polak, J. (1997) 'The IMF monetary model at forty.' Working Paper WP/97/49, IMF

Pritchett, L. (1997) 'Where has the education gone.' mimeo

R.Anand, and S. Van Wijnbergen (1989) 'Inflation and the financing of government expenditure: An introductory analysis with application to Turkey.' *World Bank Economic Review* 3(1), 17–38

Rankin, N., and B. Roffia (1999) 'Maximum sustainable debt in the overlapping generations model.' mimeo

Rebelo, S. (1991) 'Long-run policy analysis and long-run growth.' *Journal of Political Economy* 99, 500–521

Renstrom, T.U. (1996) 'Endogenous taxation: An overlapping generations approach.' *The Economic Journal* 106, 471–482

Romer, P.M. (1986) 'Increasing returns and long-run growth.' *Journal of Political Economy* 94, 1002–1037

—— (1990) 'Endogenous technological change.' *Journal of Political Economy* 98, S71–S102

—— (1994) 'The origins of endogenous growth.' *Journal of Economic Perspectives* 8, 3–22

—— (2000) 'Should the government subsidize supply or demand market for scientists and engineers.' Working Paper 7723, NBER

Saint-Paul, G., and T. Verdier (1993) 'Education, democracy and growth.' *Journal of Development Economics* 42, 399–407

San, E. (2002) 'Sustainability of fiscal policy: the case of Turkey.' MS Thesis

Sargent, T.J. (1987) *Dynamic Macroeconomic Theory* (Cambridge, Massachusetts and London, England: Harvard University Press)

Selçuk, F., and A. Rantanen (1996) *Türkiye'de Kamu Harcamaları ve İç Borç Stoku Üzerine Gözlemler ve Mali Disiplin Üzerine Öneriler* (İstanbul: TÜSİAD Publications)

Sheshinski, E. (1967) 'Optimal accumulation with learning by doing.' In *Essays on the Theory of Optimal Economic Growth,* ed. K. Shell (MIT Press, Cambridge MA.)

Stiglitz, J.E. (1974) 'The demand for education in public and private school systems.' *Journal of Public Economics* 3, 349–385

Stokey, N.L., and S. Rebelo (1995) 'Growth effects of flat tax rates.' *Journal of Political Economy* 103, 519–550

Temple, J. (2001a) 'Generalizations that aren't? Evidence on education and growth.' *European Economic Review* 45, 905–918

___ (2001b) 'Growth effects of education and social capital in OECD countries.' mimeo

Topel, R. (1999) 'Labor markets and economic growth.' In *Handbook of Labor Economics,* ed. O. Ashenfelter and D. Card (North Holland, Amsterdam)

Trehan, B., and C.E. Walsh (1991) 'Testing intertemporal budget constraint: Theory and applications to U.S. federal budget and current account deficit.' *Journal of Money, Credit and Banking* 23, 206–223

Türel, O. (1999) 'Restructuring the public sector in post-1980 Turkey: An assessment.' ERC Working Papers 99/6, Middle East Technical University

Uhlig, H. (1997) 'Capital income taxation and sustainability of permanent budget deficits.' Discussion Paper 1997/11, Tilburg University, Center for Economic Research

Under Secretariat of Treasury (2003) 'Kamu borç yönetimi raporu.' Technical Report. Nisan

Uygur, E. (2001) 'Krizden krize Türkiye: 2000 kasım ve şubat krizleri'

Uzawa, H. (1965) 'Time preference, the consumption function and optimum asset holdings.' In *Value, Capital and Growth,* ed. J.N. Wolfe (Chicago, Aldine)

Voyvoda, E., and E. Yeldan (2002) 'Beyond crisis adjustment: Investigation of fiscal policy alternatives in an olg model of endogenous growth for Turkey.' Technical Report. Paper presented at the VIth METU International Conference on Economics, Ankara

Wilcox, D.W. (1989) 'The sustainability of goverment deficits: Implications of the present-value borrowing constraint.' *Journal of Money, Credit and Banking* 21(3), 291–306

World Bank (2000) 'Turkey - country economic memorandum - structural reforms for sustainable growth, vol. i and ii.' Report No. 20657TU, September, Washington, D.C.

Yeldan, E. (1995) 'Surplus creation and extraction under structural adjustment: Turkey 1980-1992.' *Review of Radical Political Economics* 27(2), 38–72

___ (1998) 'On structural sources of the 1994 Turkish crisis: A CGE modeling analysis.' *The International Review of Applied Economics* 12, 397–414

___ (1999) 'The impact of financial stabilization and the rise of the financial rent on income inequality: The case of Turkey.' In *Rising Income Inequality and Poverty Reduction: Are They Incompatible,* ed. A. Cornia (UN-WI-DER)

—— (2001a) 'Birinci yılında 2000 enflasyonu düşürme programının değerlendirilmesi.' Şubat

—— (2001b) *Küreselleşme Sürecinde Türkiye Ekonomisi: Bölüşüm, Birikim, Büyüme* (İstanbul: İletişim Yayinları)

—— (2002) 'On the IMF-directed disinflation program in Turkey: A program for stabilization and austerity of a recipe for impoverishment and financial chaos?' In *Tha Ravages of Neo-Liberalizm: Economy, Society and Gender in Turkey,* ed. N. Balkan (New York: Nova Science Pub.)

Yentürk, N. (2001) 'Türkiye ekonomisinin son 20 yılı yangın söndü arsayı kurtardık.' mimeo

Appendix A

Equations and Variables of the OLG Model (Exogenous Growth)

Households

Intertemporal utility function ($U_t(.)$) of an agent of generation t:

$$U_t(cc_{1,t}, cc_{2,t+1}, ..., cc_{GL,t+GL-1}) = \sum_{gl=1}^{30} \beta^{gl-1} u(cc_{gl,t+gl-1})$$

Current period utility function $u(.)$

$$u(cc_{gl,t}) = \frac{1}{1-\frac{1}{\gamma}} cc_{gl,t}^{1-\frac{1}{\gamma}}$$

First-order condition for utility maximization:

$$cc_{gl+1,t+gl} = [\beta(1 + r_{t+1}(1-\tau_r))]^{\gamma} cc_{gl,t+gl-1}$$

Savings

$$pc_t s_{gl,t} = (1-\tau_i) i_{gl,t} - pc_t cc_{gl,t}$$

$$i_{gl,t} = (1-\tau_w) z_{gl} e_{gl,t} w_t + (1-\tau_r) r_t a_{gl,t}$$

$i_{gl,t}$ income of an agent of generation gl

$s_{gl,t}$ savings of an agent of generation gl

$cc_{gl,t}$, consumption of an agent of generation gl

pc_t, price of composite commodity

$a_{gl,t}$, assets of an agent of generation gl

z_{gl}, indicator for working generations

$$\begin{aligned} z_{gl} &= 1 \quad \text{if} \quad gl \leq 24 \\ &= 0 \quad \text{if} \quad 24 \leq gl \leq 30 \end{aligned}$$

$e_{gl,t}$, efficiency labor of an agent of generation gl, at time t

$$e_{1,t} = (1+\varphi)e_{1,t-1}$$

$$e_{gl+1,t+1} = e_{gl,t}$$

Production

$$Y_t = AK_t^{\alpha} L_t^{1-\alpha}$$

$$\begin{aligned} w_t L_t &= (1-\alpha) Y_t p x_t \\ r_t K_t &= \alpha Y_t p x_t \end{aligned}$$

pva_t, value added price L_t, aggregate efficiency units of labor

$$L_t = \sum_{gl=1}^{24} e_{gl,t}\bar{n}$$

$\bar{n}$, number of workers in each generation K_t, aggregate capital stock

$$pc_t K_t + B_t^D = \sum_{gl} pc_t a_{gl,t}\bar{n}$$

B_t^D, government domestic debt

Government

$$\begin{aligned} T_t &= \tau_i \left[\sum_{gl=1}^{24} (1-\tau_w) w_t e_{gl,t}\bar{n} + \sum_{gl=1}^{30} (1-\tau_r) r_t a_{gl,t}\bar{n} \right] \\ &+ \tau_w \sum_{gl=1}^{24} w_t e_{gl,t}\bar{n} + \tau_r \sum_{gl=1}^{30} r_t a_{gl,t}\bar{n} \end{aligned}$$

$$G_t = T_t - pb_t Y_t px_t$$

T_t : total taxes of the government

G_t : total expenditures of the government

px_t : producer price

pb_t : primary balance

$$B_{t+1} = (1 + r_t)B_t + G_t - T_t$$

$$B_t = B_t^D - B_t^F$$

B_t : total debt stock

B_t^D : domestic debt stock

B_t^F : foreign debt stock

$$B_{t+1}^F = B_t^F + FSAV_t$$

$FSAV_t$: foreign savings at time t

$$FSAV_t = pw_t M_t + r_t B_t^F - pw_t E_t$$

Foreign Trade and Armingtonian Specification

$$CC_t = a_c(b_c M_t^{-\nu} + (1 - b_c)DC_t^{-\nu})^{(-1/\nu)}$$

$$Y_t = a_t(b_t E_t^{\mu} + (1 - b_t)DC_t^{\mu})^{1/\mu}$$

$$\frac{M_t}{DC_t} = \left(\frac{b_c}{1 - b_c}\right)^{\sigma_m} \left(\frac{pd_t}{pw_t}\right)^{\sigma_m}$$

$$\frac{E_t}{DC_t} = \left(\frac{1 - b_t}{b_t}\right)^{\sigma_e} \left(\frac{pw_t}{pd_t}\right)^{\sigma_e}$$

CC_t : Armingtonian composite commodity

DC_t : Armingtonian domestic commodity

pd_t : domestic price of domestic good

pw_t : world price

E_t : exports

M_t : imports

$$pd_t DC_t = pc_t CP_t + G_t + I_t - pw_t M_t$$

CP_t total private consumption

$$CP_t = \sum_{gl} cc_{gl,t}$$

I_t : investment $(K_{t+1} - K_t)$

$$\begin{aligned} pm_t &= pw_t\, er_t \\ pe_t &= pw_t\, er_t \\ pc_t CC_t &= pw_t M_t + pd_t DC_t \\ px_t Y_t &= pe_t E_t + pd_t DC_t \end{aligned}$$

er_t : real exchange rate $(= 1\ \forall t)$

Commodity Market Equilibrium

$$pc_t \sum_{gl} sg_{e,t} = I_t + (B_{t+1} - B_t) - FSAV_t$$